ABSTRACT

Title of dissertation: THE ROLE OF COLLEGE STUDENTS' PERCEPTIONS OF EFFORT SOURCE ON SELF-EVALUATIONS OF ACADEMIC ABILITY

Katherine Marie Muenks, Doctor of Philosophy, 2016

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In the present studies I investigated whether college students' perceptions of effort source influenced their perceptions of the relation between levels of their own effort and ability in mathematics. In Study 1 (N = 210), I found using hypothetical vignettes that perceptions of *task-elicited* effort (i.e., effort that arises due to the subjective difficulty or ease of the task) led to perceptions of an inverse relation between one's effort and ability, and perceptions of *self-initiated* effort (i.e., effort that arises due to one's own motivation or lack of motivation) led to perceptions of a positive relation between one's effort and ability, consistent with my hypotheses and prior research. In Study 2 (N = 160), participants completed an academic task and I used open-ended questions to manipulate their perceptions of effort source. I found that participants in the task-elicited condition endorsed no overall relation between effort and ability, and participants in the self-initiated condition endorsed an overall inverse relation, which is inconsistent with my hypotheses and prior research. Possible explanations for the findings, as well as broader theoretical and educational implications are discussed.

THE ROLE OF COLLEGE STUDENTS' PERCEPTIONS OF EFFORT SOURCE ON SELF-EVALUATIONS OF ACADEMIC ABILITY

by

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2016

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Acknowledgements

I am grateful to many people for their guidance, help, and support throughout my time in graduate school and this dissertation process. First and foremost, I would like to thank Allan Wigfield and David Miele for all of the time and energy they have invested in mentoring me and helping me develop as a researcher and as a person over the past six years. Allan, thank you for taking a chance on a 21-year-old straight out of college who knew she wanted to do research on achievement motivation (but did not know much else). At the time I could have never imagined how much I would learn and grow under your mentorship. I am so thankful that I was lucky enough to be trained by such a fantastic researcher, teacher, and person. David, thank you for constantly pushing me, holding high expectations of me, and helping me develop expertise in so many areas. I am incredibly grateful for all that you have done for me as a mentor and teacher.

Kathryn Wentzel, thank you for taking me under your wing as your research assistant, and for all of your guidance, support, and feedback on my work. You have helped shape me into a confident, independent researcher. Ann Battle, thank you for all that you have done for my professional and personal development. I am so grateful for your presence throughout my time in graduate school. William (Bill) Strein, thank you for agreeing to serve on my dissertation committee and for your thoughtful and critical feedback on my work.

I would like to thank the incredible faculty at the University of Maryland who were my teachers and collaborators and who taught me so much, especially Geetha Ramani, Meredith Rowe, Laura Stapleton, Ji Seung Yang, and Patricia Alexander.

To all past and current members of the Motivation in Education Research Group: Thank you for being invaluable sources of professional and moral support. Emily Rosenzweig, I appreciate so much your presence and support in all areas of my life throughout graduate school.

Thank you to all of my fellow graduate students at the University of Maryland for teaching me new things, providing feedback and encouragement, and being a sounding board for all of my ideas, especially Kathryn Leech and Brandee Feola.

Thank you, Christina Padilla and Shannon Mahon, for your friendship and unconditional support as I navigated graduate school and wrote my dissertation.

I would like to thank the National Academy of Education/Spencer Foundation for supporting me this past year while I worked on this dissertation. I would also like to thank the Support Program for Advancing Research and Collaboration (SPARC) in the College of Education at the University of Maryland for providing funding that allowed me to do this research.

Finally, to my father, Joseph Muenks, my mother, Theresa Muenks, my brother, Kevin Muenks, and my future sister-in-law, Clara Oster: Words cannot describe how thankful I am for your love and support throughout this journey.

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Chapter 1: Introduction

Statement of Problem

In school settings, students often make assessments about their academic competence. They ask themselves questions such as: Am I good at math? How good am I compared to the best student in the class? Can I succeed on this upcoming test or assignment? Overall, how smart am I in school? In general, students of all ages who are confident in their own academic abilities tend to utilize effective self-regulatory strategies, set high goals and aspirations, exhibit persistence in the face of difficulty, and perform well on tests of achievement or learning (e.g., Bandura & Schunk, 1981; Bouffard-Bouchard, Parent, & Larivee, 1991; Pajares, 1996a). Students are also more likely to value, be interested in, and choose to take classes in the fields or domains they feel competent in (e.g., Dennissen, Zarret, & Eccles, 2007; Durik, Vida, & Eccles, 2006; Simpkins, Davis-Kean, & Eccles, 2006). College students' beliefs about their abilities are particularly important, as they are predictive of their adjustment to college, choice of major, grades, retention, and career prospects (e.g., Chemers et al., 2001; Lent et al., 1986; Robbins et al., 2004; Zajacova et al., 2005).

Given that students' evaluations of their abilities are associated with critical school-related outcomes, it is important to investigate how these evaluations are formed and what influences these evaluations. Previous research suggests that a useful indicator of one's academic ability is the amount of *effort* one exerts on academic tasks, and that high effort can be interpreted as an indicator of either high or low ability (e.g., Harari & Covington, 1981; Kun, 1977; Nicholls, 1978). Thus, individuals can either conceive of a *positive* relation between levels of effort and ability, or an *inverse* relation between levels of effort and ability. Two researchers, John Nicholls (1978, 1984) and Carol Dweck (1999; Dweck & Leggett, 1988), developed different theories of how individuals form ability evaluations of themselves and others based on effort information, and in what circumstances individuals may conceive of a positive or an inverse relation between levels of effort and ability.

As will be described in more detail below, while Nicholls (1984) argued that developmental and situational forces change whether one conceptualizes ability as "differentiated" or "undifferentiated" from effort, Dweck (1999) argued that individuals' beliefs about the nature of intellectual ability—specifically, whether they believe it is a fixed capacity or something that can be improved with practice—can influence whether they conceive of a positive or inverse relation between amount of effort and ability. However, both theorists primarily emphasized the importance of *ability* beliefs or conceptions in predicting how individuals will conceive of the relation between amount of effort and ability in a given achievement situation.

Less research has examined aspects of *effort* that may influence how individuals relate the amount of effort they exert to evaluations of their own ability. In the present dissertation studies, I examined one aspect of effort that previous research has not examined extensively: The perceived *source* of one's effort. As will be discussed in more detail later, I propose that the effort that individuals exert can be perceived as arising primarily from either external or internal sources. Individuals who perceive their own or another's effort as externally driven by their perceptions of the task at hand—which I refer to as *task-elicited* effort—will be likely to endorse an inverse relation between amount of effort and ability. Conversely, individuals who perceive their own or another's effort as internally driven by the individual's own motivation—which I refer to as *self-initiated* effort—will likely endorse a positive relation between amount of effort and ability. As will be discussed later, there are important broader motivational implications of perceiving one's effort as either task-elicited or self-initiated, and the implications of effort source for motivation are a main focus of the studies proposed here.

Theoretical Frameworks

Two theoretical frameworks underlie the different foci of the proposed studies. First, I utilized premises from social comparison theory as a rationale for examining both how students evaluate their *own* abilities as well as how they evaluate *other* students' abilities with respect to different sources of effort. Researchers studying social comparison have found that students use information about other students when forming their self-evaluations, and that students often tend to choose to compare themselves with similar others (e.g., Blanton, Buunk, Gibbons, & Kuyper, 1999; Wheeler, 1966; Wheeler, Koestner, & Driver, 1982). Thus, in the proposed dissertation studies I examinined how students' perceptions of the source of effort influenced their ability evaluations of themselves as compared to others.

Second, because the central purpose of the proposed dissertation studies was to examine students' perceptions of the relation between levels of effort and ability, classic attribution theory provided the overarching theoretical framework (Heider, 1958; Weiner, 1986). Weiner (1986), one of the original attribution theorists, identified effort and ability as two of the main things students use to explain their successes or failures to in school. Nicholls (1978, 1984) and Dweck (1999; Dweck & Leggett, 1988) attempted to explain how individuals form evaluations of ability based on information about effort, and so their extensions of attribution theory are important parts of this overarching theoretical framework.

As discussed in more detail in Chapter 2, Nicholls (1978) suggested that children go through developmental levels in their understanding of effort and ability, eventually reaching the conclusion around 10-13 years of age that effort and ability are distinct constructs that are inversely related to one another. That is, in many cases, a person with high ability can exert less effort than a person with low ability and still achieve the same outcome. For example, if Sarah finishes a puzzle with less effort than Emily, Sarah likely has a higher level of puzzle-solving ability than Emily. However, he argued that just because older children and adults are *able* to conceptualize an inverse relation between amount of effort and ability does not mean that they do so across all situations and contexts (Nicholls, 1984). He argued that in academic contexts focused on competition and social comparison (what he called *ego-involving* situations), individuals are likely to conceptualize ability as “differentiated” from effort and, thus, to conceive of an *inverse* relation between levels of effort and ability. Conversely, in academic contexts that are focused on one’s own learning and growth (what he called *task-involving* situations), individuals are likely to conceptualize ability as “undifferentiated” from effort and, thus, to conceive of a *positive* relation between levels of effort and ability. Thus for Nicholls both developmental and situational factors impact individuals’ thinking about effort and ability.

Carol Dweck (1999; Dweck & Leggett, 1988) also posited that individuals could conceive of a positive or inverse relation between the quantity of effort and ability. However, she suggested that the main determining factor in individuals’ thinking about this relation was differences in their stable lay conceptions of ability rather than more transient situational factors such as the achievement context. While some individuals hold a lay conception of ability as a set of malleable skills or competencies that can improve with effort and practice, others view ability as a stable, fixed entity that cannot improve over time. From the former perspective, individuals would be likely to view the quantity of effort and ability as positively related; from the latter perspective they would be likely to view the quantity of effort and ability as inversely related.

Although both theories provide compelling reasons for why differences exist in individuals' perceptions of how the quantity of effort relates to ability, neither adequately predicts how individuals will perceive this relation across a broad range of achievement situations. For example, Nicholls (1984) suggested that in competitive situations, all mature individuals will adopt the differentiated conception of ability and thus perceive the quantity of effort and ability as inversely related. But, there seem to be cases in which some people view effort and ability as positively related even within ego-involved situations (e.g., Hong, Chiu, Dweck, Lin, & Wan, 1999; see further discussion of this study in Chapter 2). Similarly, Dweck (1999; Dweck & Leggett, 1988) posited that a significant proportion of individuals conceive of ability as malleable (i.e., incremental theorists) and that these people will generally perceive the quantity of effort and ability to be positively related. However, in certain achievement scenarios, such as when individuals are evaluating the abilities of two students who exert different levels of effort but receive the same grade, it appears that nearly every mature individual perceives effort and ability to be inversely related (e.g., Nicholls, 1978).

One potential reason why Nicholls (1984) and Dweck's (1999) theories may not fully predict how individuals perceive the relation between quantity of effort and ability across contexts may be that they both focus on how individuals' conceptions of *ability* (i.e., as differentiated vs. undifferentiated or fixed vs. malleable) influence their perceptions of the effort-ability relation, without focusing on aspects of *effort*, such as individuals' perceptions of the *source* of effort. Perhaps taking into account this additional information would allow for a more complete understanding of what influences how individuals think about relation between levels of effort and ability.

As noted earlier, I propose that effort can be construed as arising from two different sources: the perceived difficulty or ease the task itself (i.e., *task-elicited* effort), or the individual's own motivation (i.e., *self-initiated* effort). If people perceive that their effort on a particular task is primarily elicited by the properties of the task (i.e., was task-elicited), they might conceive of ability as an innate capacity and thus endorse an inverse relation between the quantity of effort and their ability. That is, the harder they *must* to work to complete a task, the lower their ability. On the other hand, if people primarily perceive that they put forth effort willingly because they are motivated (i.e., effort was self-initiated), they might conceive of ability as a set of skills or competencies and thus endorse a positive relation between levels of effort and ability. That is, the harder they *choose* to work to complete a task, the higher their ability is. This is because exerting a lot of effort on an academic task would be interpreted as a sign that they are highly motivated to increase their abilities. Thus, it might be important to consider how someone perceives the *source* of their own (or another person's) effort in order to understand the ways in which that person relates quantity of effort and ability in an achievement scenario.

My definitions of and hypotheses about these two sources of effort were inspired by work in cognitive psychology conducted by Koriat, Ma'ayan, and Nussinson (2006). Koriat et al. (2006) identified two different types of regulation that individuals use when completing academic tasks, which they called data-driven and goal-driven regulation. In a series of studies reviewed in more detail in Chapter 2, undergraduate participants completed word memorization tasks under different timed learning conditions. The researchers then examined the correlation between the amount of time participants spent on each word and their evaluation of how well they memorized that word. *Data-driven regulation*, which was used when participants completed the tasks under no time pressure, was characterized by a negative correlation between time spent on each word and participants' judgments of how much they had learned (i.e., judgments of learning; JOLs). This suggests that participants were using effort as an indicator of how much they had learned; spending more time on a particular word meant the participants believed they were less likely to recall that word later. *Goal-driven regulation*, which was used when participants completed the tasks under time pressure, was characterized by a positive correlation between time spent on each word and participants' JOLs. In these cases, Koriat el al. (2006) suggested that participants targeted their effort to do well on the words they thought they could learn; thus effort was used a tool to improve their performance. In sum, these studies suggest that there is a qualitative component to effort that is not discussed in either Nicholls' (1984) or Dweck's (1999) theories. Importantly, however, Koriat et al. (2006) did not examine how these different types of effort influenced participants' evaluations of ability more generally, but instead focused on their specific judgments of learning for specific words. In the present dissertation studies, I directly examined how individuals' perceptions of the source of their own or others' effort impacted their self-evaluations of ability. Because my focus was slightly different than Koriat et al.'s (2006), I decided to use the terms *task-elicited* effort instead of data-driven effort, and *self-initiated* effort instead of goal-driven effort, in order to distinguish my work from theirs.

Although only one known study has directly examined task-elicited and self-initiated effort (Muenks, Miele, & Wigfield, in press, discussed more below), Gail Heyman and her colleagues (Heyman, Gee, & Giles, 2003; Heyman & Compton, 2006) found that when young children were told that a hypothetical character thought a task was difficult or easy, they were more likely to endorse an inverse relation between amount of effort and ability than when they were told that a hypothetical character simply worked hard or did not work hard. These studies suggest that certain effort cues may impact how children conceive of the relation between amount of effort and ability. However, there is some disagreement in the literature as to whether young children are able to fully understand and differentiate between concepts of effort and ability (Nicholls, 1978; Karabenick & Heller, 1976; Surber, 1980; Harari & Covington, 1981) and so it is difficult to form any strong interpretation of these results.

In order to address these developmental concerns and examine task-elicited and self-initiated effort more directly, Muenks et al. (in press) gave undergraduate students hypothetical vignettes in which characters' effort was described as task-elicited or self-initiated. They also varied the levels of effort the characters exerted and examined participants' ability evaluations of those characters. Muenks et al. (in press) found that, in the absence of explicit performance information, participants who were given task-elicited effort cues (e.g., about ease/difficulty of the task being completed) were likely to endorse an inverse relation between amount of effort and ability, whereas participants who were given self-initiated effort cues (e.g., about motivation/lack of motivation to engage in a task) were likely to endorse a positive relation between amount of effort and ability. Muenks et al. (in press) therefore found evidence that changing the way that effort source is described can change whether students view high effort as an indicator of low ability or not. Although these studies suggest that students' perceptions of effort source influence their thinking about the relation between levels of effort and ability, these studies focused on students' evaluations of *others*, and did not connect these evaluations to students' own evaluations of *themselves*.

Purpose of the Proposed Studies and Hypotheses

The purpose of the proposed studies was to examine whether college students' perceptions of the source of their own effort (i.e., whether it is task-elicited or self-initiated) influence their ability evaluations of themselves as compared to another student, given the amount of effort they exert on a task relative to the other student. I examined this by utilizing a vignette methodology (Study 1), and having participants actually complete an academic task (Study 2). These studies extended those conducted by Muenks et al. (in press), which only examined students' evaluations of other students, and provided crucial new information regarding individuals' self-evaluations of ability.

My hypotheses are as follows:

1. When college students perceive their own effort as task-elicited, that is, arising from the demands of the task itself (i.e., ease or difficulty), they will evaluate their own ability lower than another person when they exert more effort than that person, and higher than another person when they exert less effort than that person. Specifically, in Study 1, I expect to find that participants in the task-elicited, low effort condition will increase their ability evaluations from the first to the second evaluation (i.e., once they receive effort source information), whereas participants in the task-elicited, high effort condition will decrease their ability evaluations from the first to the second evaluation. I expect that the average difference score between the high effort condition and the low effort condition will be significantly negative, suggesting an inverse relation between effort and ability. In Study 2, I expect that participants in the task-elicited high effort condition will evaluate their own ability (as compared to the other student) *lower* than participants in the task-elicited low effort condition.
2. When college students perceive their own effort as self-initiated, that is, arising from their own motivation to engage in the task, they will evaluate their own ability higher than another person when they exert more effort than that person, and lower than

another person when they exert less effort than that person. Specifically, in Study 1, I expect to find that participants in the self-initiated, low effort condition will decrease their ability evaluations from the first to the second evaluation (i.e., once they receive effort source information), whereas participants in the self-initiated, high effort condition will increase their ability evaluations from the first to the second evaluation. I expect that the average difference score between the high effort condition and the low effort condition will be significantly positive, suggesting a positive relation between effort and ability. In Study 2, I expect that participants in the self-initiated high effort condition will evaluate their own ability (as compared to the other student) *higher* than participants in the self-initiated low effort condition.

The rationale for these hypotheses is as follows: When one's effort is perceived as driven by external forces such as the subjective difficulty of the task, it is viewed as something that the individual *must* do, and therefore having to exert high levels of effort is an *indicator* that the person lacks ability. Conversely, when one's effort is perceived as driven by internal forces such as the individual's own motivation, it is viewed as something that the individual *chooses* to do, and therefore exerting high levels of effort is a sign that the person is motivated to *increase* his or her ability. Thus, changing individuals' perceptions of the source of their own effort may impact whether they believe high effort is indicative of low or high ability.

Contributions

The proposed dissertation studies added critical new information to the literature on college students' motivation by extending our current knowledge of how students define and think about effort as it relates to ability. They made three primary theoretical contributions. First and most importantly, although a large body of research has examined how the quantity or amount of individuals' effort relates to evaluations of their ability, only one known study (e.g., Muenks et al., in press) has directly manipulated or measured students' perceptions of the *source* of their own or another's effort. Thus, more research is needed in order to determine whether effort source is a useful construct that could extend existing theories on students' thinking about effort and ability. Perhaps this aspect of effort, which focuses more on *why* the effort was exerted rather than how *much* was exerted, will lead to more complete predictions of how one forms ability evaluations. The present studies extended extant literature by focusing on an aspect of effort that has been rarely explicitly examined in a school-related context before.

Second, the proposed dissertation studies extended the Heyman studies (Heyman et al., 2003; Heyman & Compton, 2006) by examining how perceptions of effort source influence ability evaluations in college students. Although Heyman and colleagues studied the influence of effort cues on the ability evaluations of young children (aged 5-10 years), researchers tend to disagree as to how much children of these ages understand about the distinction between concepts of effort and ability (e.g., Nicholls, 1978; Karabenick & Heller, 1976; Surber, 1980; Harari & Covington, 1981). Thus, it is crucial to study how effort source information impacts ability evaluations in college students. With this sample, I can be certain that all participants are cognitively mature enough to differentiate between concepts of effort and ability, and can understand the inverse relation between the two. Additionally, the Koriat et al. (2006) studies all utilized college students as participants. The proposed dissertation studies provided an extension of those studies by using a similar sample, but examining how students' perceptions of effort source influence their evaluations of ability, not just their judgments of learning for a specific task.

Finally, I examined how individuals formed evaluations of their *own* ability as compared to others, given information about the source of effort. Previous studies have either only measured participants' own judgments of learning for a specific task, as in the Koriat studies (e.g., Koriat et al., 2006), or participants' ability evaluations of other individuals (e.g., Heyman & Compton, 2006; Muenks et al., in press). The proposed dissertation studies were the first to examine how individuals use information about the source of their *own* effort when evaluating their *own* ability. As discussed above, there is ample research demonstrating that students' evaluations of themselves influence their motivation and achievement-related behavior (e.g., Wigfield et al., 2015). It was therefore critical to connect students' perceptions of effort source to their own evaluations of themselves, not just their evaluations of others.

Although the present studies may not have any direct practical implications, information gleaned from these studies can potentially inform future intervention efforts. For example, it is possible that some students hold assumptions or perceptions about others' effort that make them feel discouraged in school. Maybe they assume that other students' lack of effort on school assignments is due to those students' feelings of ease with the task rather than their lack of motivation. Students who are working hard may then incorrectly assume that everyone else is breezing through the task, while they are struggling, and conclude that they must not be as smart as everyone else. Perhaps in certain situations, it is motivationally useful for students to shift the way they are thinking about their own and others' effort. With more research, interventions could be formed to help students manage these beliefs and perceptions, with the ultimate goal of increasing students' competence beliefs.

Definition of Terms

Ability. Defined by Nicholls (1978) as "what a person can do" (p. 800).[1]

Ability evaluation. One's determination of the quantity of ability present in themselves or others.

Effort. Energy exerted on a task. "Quantity" or "levels" of effort will refer to the amount of effort exerted in a given situation.

Perceptions. I will often use the phrase "*perceptions* of the source of effort." I specifically note that these are subjective interpretations rather than reality. One's effort is likely *actually* driven by many sources simultaneously, but what I am focused on in these studies is what one perceives as the primary source driving their own or another person's effort.

Self-initiated effort. Effort that arises due to one's internal motivation or lack of motivation. The motivation may stem from a number of different factors.

Source of effort. What *drives* one's effort on a task, specifically whether one's effort is driven by the perceived ease or difficulty of the task (task-elicited effort) or one's own motivation or lack of motivation (self-initiated effort).

Task-elicited effort. Effort that is externally driven and is required from a given task for a particular individual.

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[1] As will be discussed more in Chapter 2, the definition of ability and its relation to intelligence has been debated in the literature (e.g., Nicholls, Patashnick, & Mattetal, 1986; Dweck, 1999), although researchers agree that individuals' definitions of ability can *change* based on developmental, situational, and individual difference factors.

Chapter 2: Literature Review

As discussed in Chapter 1, students who believe that they are competent in school tend to be more motivated and perform better academically than students who do not (Bandura, 1997; Wigfield et al., 2015). The present dissertation studies focused on how one particular aspect of effort, the perceived *source* of one's effort, influenced college students' evaluations of their own ability compared to that of another student. In this chapter I summarize the relevant research regarding the important role of social comparison information in students' self-evaluations and what developmental, situational, and individual factors influence how students conceptualize the relation between quantity of effort and ability. In this chapter I also describes in detail the theoretical framework for and prior work relating to the effort source construct that I examined.

The chapter is organized as follows: First, I discuss social comparison theory (Festinger, 1954; Wood, 1989) because as noted in Chapter 1 social comparison processes are important to consider when examining how students form evaluations of their own abilities. Second, I discuss work on individuals' beliefs about ability and effort and their interrelations. I begin with attribution theory (Weiner, 1972) as it provides the theoretical foundation for Nicholls (1978, 1984) and Dweck's (1999; Dweck & Master, 2009) work on ability and effort. Third, I discuss Nicholls and Dweck's theories in more detail and review empirical findings that support them. Fourth, I discuss more fully what I mean by effort source, and describe two major sources, which I call task-elicited and self-initiated effort. I review some empirical evidence for the distinction between these two sources and distinguish my view of effort source from that of Koriat et al. (2006). Finally, I discuss the contributions my studies will make to the literature.

Social Comparison Theory

In the proposed dissertation studies I examined how perceived effort source influenced individuals' evaluations of their own academic abilities as compared to others. It is therefore important to review the literature on social comparison theory briefly. A full review goes beyond the scope of the kinds of focused social comparative evaluations relevant to academic ability focused on here.

Social comparison theory originated with Leon Festinger (1954), who attempted to provide explanations for why and how individuals evaluate themselves through comparisons with others. Although Festinger (1954) made a large number of hypotheses regarding social comparison, I will focus on three of his hypotheses here that are particularly relevant to the present dissertation studies. First and foremost, he argued that people feel compelled to make accurate evaluations of their abilities. Second, he argued that, if individuals are unable to make these evaluations using objective information with reference to the physical world (such as evaluating their ability to jump across a stream by actually jumping across it), they often use other people as a source of information about how well they are doing. For example, if a person wanted to evaluate his chess ability, he would likely compare his chess performance with other chess players. Third, Festinger hypothesized that in order to make accurate evaluations of their abilities in different areas, individuals must compare themselves with other individuals who have a *similar* level of ability. For example, if a sixth-grade student is trying to get an accurate sense of her current math ability, she will need to compare herself with similar others, such as other sixth-grade students in her math class, rather than first-grade students or college-aged mathematics majors.

Empirical work generally supports these three hypotheses, although it is important to note that most of the work on Festinger's (1954) original theory was conducted in the 1960s, 70s, and 80s. More recently, researchers have focused their attention on extensions and elaborations of the original theory (e.g., upward/downward social comparisons, Big Fish Little Pond effect, etc.) that are not as relevant to the current dissertation studies. I will therefore focus on some of the older empirical work that examined the three hypotheses described above. Trope (1982) tested the first hypothesis that individuals feel compelled to accurately evaluate their abilities. Middle school-aged participants were given either straightforward or conflicting results about their performance on a mental flexibility task and then asked to a complete a new task that was either diagnostic or undiagnostic of their ability. Participants who received conflicting results about their performance (and were therefore uncertain about their ability) worked harder on the diagnostic task than participants who received straightforward results, which suggests that these participants were concerned with accurately evaluating their ability. More recently, researchers have suggested that in addition to accurate self-evaluation, individuals have a need for self-enhancement and self-improvement; however, this research will not be reviewed in detail here (see Wheeler & Suls, 2005, for a review).

In support of the second hypothesis, Scheier and Carver (1983) found that undergraduate participants' self-directed attention during a task (which was experimentally induced with the use of a mirrored surface or a live observer) increased participants' tendencies to seek out information about how other undergraduate students performed on the task. Because participants were induced to have high levels of self-focus and did not have any objective means to evaluate their ability, they sought out information about other participants in order to form their self-assessments. The third hypothesis, that individuals use similar others as a basis for comparison, has been examined extensively in the literature (see Wood, 1989, for a review). In one study, Wheeler (1966) found that undergraduate participants were more likely to choose to compare their scores on a personality test (that was used for selection into a desirable or undesirable seminar) to similarly ranked others rather than dissimilarly ranked others. Similarly, Wheeler, Koestner, and Driver (1982) found that undergraduate participants who completed a task after a certain amount of practice chose to compare their performance with other participants who engaged in the same amount of practice as they did. More recently, researchers have argued that individuals may, in certain contexts, be compelled to compare themselves to higher performing individuals (i.e., upward comparisons) or lower performing individuals (i.e., downward comparisons), although the relevant literature will not be reviewed in detail here (see Wheeler & Suls, 2005).

As a whole, previous research suggests that individuals are driven to form accurate self-evaluations in academic contexts, and that they often use similar others as a basis of comparison when forming these evaluations. Many of these studies utilized college participants, which suggests that social comparison processes are important for this population. However, it is important to note that although social comparison processes appear to be important for many people, research suggests that there are individual differences in the extent to which individuals engage in social comparison (e.g., Gibbons & Buunk, 1999). In the present dissertation studies, college participants were asked to make evaluations of their own ability as compared to a similar student. They also completed several items that I created based loosely on the Iowa-Netherlands Comparison Orientation Measure (Gibbons & Buunk, 1999) that measured the extent to which they rely on information about others to form their own self-assessments in academic settings.

I next discuss the main theories dealing with individuals' beliefs about their ability that provide the overarching theoretical context for the present studies.

Attribution Theory

In order to better understand current research on the perceived relation between effort and ability, it is useful to consider the ways in which these concepts were originally articulated by attribution theories of motivation. Attribution theorists aim to explain how individuals interpret outcomes and events in terms of their causes. The theories stem, in part, from Heider's (1958) theory of naïve analysis of action, which suggests that human beings are like scientists who are constantly attempting to determine causal relationships in their world. Heider proposed that analyzing others' actions allows individuals to understand and influence their own and others' behavior and to predict future actions. Attribution theory can be applied to academic contexts by explaining how students make sense of academic outcomes, such as receiving a high grade on an assignment or failing a test (e.g., Nicholls, 1975; Nicholls, 1976).

Heider (1958) distinguished between two different conditions of action: "can" and "try." Can is defined as "the relation between the power or ability of the person and the strength of the environmental forces" (Heider, 1958, p. 86). He describes can as a function of both ability and environmental difficulty, where only those with greater ability (defined as a stable, dispositional characteristic) can succeed at more difficult tasks. While can represents what he calls the power factor of personal force, try represents the motivational factor. Try, which is similar to effort, also includes two elements: intention and exertion. Intention is defined as wishing or wanting to do something, while exertion is how hard a person tries to do it. Thus, Heider suggested that there is a qualitative aspect to effort (i.e., intention) that is distinct from the quantity of effort one puts forth (i.e., exertion). Although Heider argues that intention guides individuals to work toward desired outcomes, exertion is more easily perceived by others and thus more often used as a means of determining another's effort. Heider described exertion as varying directly with the difficulty of the task and inversely with the ability of the person. In other words, if the task is held constant, the person with less ability will have to exert himself more to succeed.

Both Kelley (Kelley & Michela, 1980) and Weiner (1986) preserved the notion of an inverse relation between effort and ability in their own attribution theories. Weiner, whose theory has been particularly influential within educational psychology, discussed four main causes of success or failure at academic tasks: ability, effort, task difficulty, and luck (Weiner et al., 1971). Out of these four, Weiner and colleagues found that attributions to effort and ability tended to be the most salient. Weiner (1986) delineated three dimensions or ways that attributions could vary: by locus, stability, and controllability. The most fundamental distinction was internal versus external locus (similar to Heider's [1958] distinction between personal and environmental factors). Weiner (1986) described ability and effort as internal factors, as they reside within the person, and task difficulty and luck as external factors, as they reside outside of the person. The second dimension was stability. Weiner et al. (1971) characterized ability as a stable and constant capacity, and effort as variable and unstable. However, later Weiner (1979, 1985) distinguished between what he called *stable* effort (which likely reflects an individual difference in how effortful one is in general) and *immediate* effort (which is more unstable and is brought about by the current situation one is in; see also, Graham & Williams, 2009). In the present set of studies, when I refer to "effort" I will be focusing on *immediate* effort as defined by Weiner (1979). Weiner (1985) also noted that ability could be perceived as unstable by some individuals. The third dimension was controllability, which was defined as whether or not the individual has volitional control over the perceived cause. Weiner (1986) described effort as controllable and ability as uncontrollable. Thus, although he recognized that these classifications could vary, Weiner (1985, 1986) characterized ability as internal, stable, and uncontrollable, and effort (specifically *immediate* effort) as internal, unstable, and controllable. These characterizations of ability and effort suggest that, in an achievement situation, they would be perceived as inversely related to each other: because ability is stable and uncontrollable, it appears that it cannot be substantially increased with effort.

I will argue, later in the paper, that there are differences in the way that people perceive the *source* of another's effort, and these differences can lead to variation in the way that they perceive the relation between the amount of effort one exerts and one's ability. Specifically, I propose that, although effort is internal and controllable in the sense that it comes from within individuals and individuals have control over how much effort they exert, it can be *perceived* by different individuals as being driven primarily by either the subjective difficulty of the task (which is more external and uncontrollable), or one's own motivation (which is more internal and controllable), and that these perceptions may then influence how individuals relate levels of effort to ability (e.g., Heyman & Compton, 2006; Heyman, Gee, & Giles, 2003; Muenks, Miele, & Wigfield, in press). Thus, in the present studies I sought to extend Weiner's (1986) attribution theory by examining whether individuals' *perceptions* of effort in particular situations or contexts differed somewhat from the way that Weiner (1986) characterized immediate effort along the three dimensions. I am also interested in the extent to which individuals characterize ability as either stable/uncontrollable (i.e., inversely related to effort) or unstable/controllable (i.e., positively related to effort) based on their perceptions of effort source.

These attribution theorists provide a theoretical foundation that broadly explains how individuals' causal reasoning influences their motivations and emotions. They also lay the groundwork for the two main theoretical frameworks that link quantity of effort to ability (e.g., Nicholls [1978, 1984] and Dweck [1999; Dweck & Master, 2009]) by introducing the idea that students' attributions to effort and ability are motivationally important, describing characteristics of these attributions, suggesting that there are both motivational (intention) and quantifiable (exertion) components to effort, and by introducing the idea that ability is fixed and that exertion is inversely related to the ability of the person. This idea is expanded on in Nicholls' (1978, 1984) theory described below.

Nicholls' Theory of Ability Conceptions

As discussed briefly in Chapter 1, Nicholls' theory of ability conceptions (Nicholls 1978, 1984) builds on attribution theory by specifically examining what developmental and situational factors influence how individuals think about effort and ability in school-related contexts. He defined ability as "what a person can do" (Nicholls, 1978, p. 800) and adopted Heider's (1958) assumption that ability limits the extent to which high levels of effort can increase performance. Nicholls' theory consists of two main components. The first component is primarily developmental and explains how children's reasoning about ability changes over time, while the second component is situational and explains why mature individuals might adopt different conceptions of ability in different contexts.

In Nicholls' (1978) original developmental study, participants ages 5 through 13 were shown videos of two eight-year-old children working on math problems at their desks. One child in the video spent all of the time looking at the text or writing in the workbook (high effort), while the other child spent half of the time working and half of the time doing non-work activities, like fiddling with an eraser or looking around the room (low effort). Participants were then told either that both children got the same number of answers correct on the math problems (either 2 out of 10 or 10 out of 10), or that the child who worked continuously got a lower score (2 out of 10) than the child who worked intermittently (8 out of 10). The participants were then asked to determine which child from the video worked harder and which child was cleverer (or smarter), and explain their reasoning. The researchers did not give the participants a definition for “cleverness” or “smartness” and left it up to the children to define for themselves.

Based on a qualitative analysis of the data, Nicholls (1978) proposed four levels of reasoning about others’ effort and ability. Each level was associated with a qualitatively distinct form of reasoning, and each higher level was a more advanced restructuring of the previous level. In the first level (age 5-6 years), effort, ability, and outcome were not distinguished from each other. Children tended to focus primarily on effort as an indicator of high ability. For example, children believed that the character from the video that tried harder was smarter, even if they got a lower score. In the second level (age 7-9 years), effort and outcome were distinguished as cause and effect (i.e., different levels of effort lead to different outcomes), but ability was not acknowledged as a cause of outcome because it was still conflated with effort. Thus, children tended to believe the character that got the higher score tried harder and was more able. In the third level (age 9-11 years), the distinction between effort and ability was partially established; effort was no longer the sole cause of outcomes. However, this reasoning was not consistently applied. In the fourth level (age 10-13 years), ability was clearly differentiated from effort, and the two were seen as independent causes of outcomes. Furthermore, ability was seen as a capacity that could limit or increase the effectiveness of effort. Based on these findings Nicholls (1978) suggests that most children go through a series of developmental levels in their reasoning about effort and ability and eventually come to the “mature” conclusion that amount of effort and ability have an inverse relation to one another with respect to outcome (e.g., you need less of one if you have more of the other in order to reach the same outcome).

Two central claims to the developmental component of Nicholls' (1978) theory were abstracted: First, young children do not conceptually differentiate between effort and ability, but older children and adults do. Second, as children develop they become more sophisticated in the way they think about the relation between quantity of effort and ability. Nicholls (1978) suggested that this occurs because young children do not yet have the cognitive maturity to understand the relation between task difficulty and incentive value (i.e., that succeeding on difficult tasks is better than succeeding on easy tasks; also see Nicholls & Miller, 1983). Thus, they perceive their attainment less accurately and make attributions less logically than older children. Younger children have also not had much experience with repeated success and failure. However, as they grow and develop, they begin to understand that exerting high effort can be an indication of low ability.

Both of Nicholls' (1978) developmental claims have received support from empirical studies. First, a number of studies provide support for the idea that young children cannot differentiate effort from ability (e.g., Yussen & Kane, 1985; Stipek & Daniels, 1990; Bempechat, London, & Dweck, 1991). Stipek and Tannatt (1984) interviewed children in preschool through third grade about which students in their class were the best and worst at work- and play-related tasks, which were the best and worst thinkers, and which were smartest and least smart. For children of all ages, the concepts of effort, ability, and conduct were confounded. Children who behaved well in school were seen as putting forth more effort, and those who put forth more effort were seen as having higher ability. These results suggest that effort and ability do not emerge as distinct concepts until after third grade. In another study, Skinner (1990) gave 509 children in grades 1-6 questionnaires measuring their beliefs in the effectiveness of five different potential factors on school outcomes, two of which were effort and ability. She then conducted exploratory factor analyses and found that the factor structure of children's means-ends beliefs (i.e., the extent to which children believed that these factors would affect school-related outcomes) differed by age. At younger ages (7-8 years), effort and ability loaded onto the same factor, but the factor structure became more and more differentiated over time, with children ages 11-12 being able to fully differentiate effort from ability. She concluded that children's beliefs about effort and ability become more differentiated throughout middle childhood.

The second claim Nicholls (1978) made in the developmental component of his theory is that children begin to reason about quantity of effort and ability in more sophisticated ways once they are able to distinguish between the two. Initial support for this claim comes from a study by Kun, Parsons, and Ruble (1974) with a sample of children aged 6-11 years and adults. Kun et al. (1974) found that an understanding of the multiplicative relation between effort and ability (i.e., when combining effort and ability information to predict performance, performance will be zero if either effort or ability is zero) emerges around age 10. Six-year-old children used an additive, rather than multiplicative model to explain the relation between effort and ability; that is, they believed that effort facilitates performance equally regardless of ability. Eight-year-olds were somewhere in the middle between an additive model and a multiplicative model, suggesting that there is a transitional stage. Thus, these studies provide support for Nicholls' (1978) claim that children go through increasingly advanced developmental stages in their reasoning about the relation between quantity of effort and ability as they get older, although Kun et al. (1974) framed the developmental stages slightly differently than Nicholls (1978).

Further evidence for Nicholls' (1978) second claim comes from a study by Kun (1977) that explored the development of conceptions of effort and ability with respect to explanations about success on an academic task. She specified two inference rules that people might use. First, people might use a magnitude-covariation schema, which involves understanding that an increase in the magnitude of an effect (e.g., success on a task) was preceded by an increase in the magnitude of a facilitative cause (e.g., ability or effort). Second, people might use a compensation schema, which involves understanding that when an effect is invariant, a change in the magnitude of one cause was accompanied by a compensating change in the magnitude of a second cause. Kun (1977) distinguished between two types of compensation schemas: A direct compensation schema, where the strength of the two causes changes in the *same* direction (e.g., an increase in effort occurs at the same time as an increase in task difficulty), and an inverse compensation schema, where the strength of the two causes changes in *opposite* directions (e.g., an increase in ability is counteracted by a decrease in effort). Results from a series of studies with elementary school and college students suggested that the magnitude-covariation schema develops first, then the direct compensation schema, and finally the inverse compensation schema. Together, Kun's (1977) results suggest that as children get older, they learn to combine effort, ability, and outcome information in ways that are consistent with an inverse relation between amount of effort and ability.

A number of subsequent studies have also explored developmental changes in children's reasoning about quantity of effort and ability. A study by Nicholls and Miller (1984) extended Nicholls' (1978) original study by including self-evaluations of effort and ability in addition to evaluations of others. Results supported Nicholls' (1978) claim that a perceived inverse relation between quantity of effort and ability (in self and others) emerges around the fifth or sixth grade.

Miller (1985) found that older children who have a developed a "mature" conception of ability (by Nicholls' [1978] definition) use self-protective strategies, such as not putting in as much effort to a task when they cannot attribute failure at that task to something other than their ability (see also Juvonen & Murdock, 1995). This pattern was not found for the younger children, suggesting that only the older children understood that high effort was indicative of low ability. Graham and Barker (1990) focused on effort and ability attributions that children make in response to helping behavior, and found that positive effort-ability correlations were highest for the youngest age group and declined over time, eventually becoming negative for the oldest age group.

Droege and Stipek (1993) asked 80 children in kindergarten, third grade, and sixth grade to report their perceptions of the stability of others' academic competence. Results indicated that younger children were more optimistic than older children in terms of both the malleability and potential for improvement of academic competence. In other words, the older children (sixth graders) believed that ability was more fixed and less influenced by effort than the younger children (kindergarteners and third graders). This finding suggests that older children are beginning to understand that effort and ability can be inversely related (see also Rholes & Ruble, 1984; Rholes, Blackwell, Jordan, & Walters, 1980; Rholes, Jones, & Wade, 1988).

Several additional studies provide support for the idea that the relation between perceptions of quantity of effort and ability develop over time, but do not provide support for the specific age-related levels as Nicholls (1978) defines them. For example, several studies demonstrate that young children can reason about ability and effort earlier than Nicholls (1978) proposes (e.g., Karabenick & Heller, 1976; Surber, 1980; Wimmer, Wachter, & Perner, 1982; Schunk, 1983). Karabenick and Heller (1976) found that children as young as six tended to attribute lower levels of effort to a character who had higher ability, showing an appreciation for the inverse relation between effort and ability. Surber (1980) asked 229 children in grades K-5 and 113 adults judge the ability, effort, or performance of hypothetical 8-year-old boys in a weight lifting contest given ability, effort, and/or performance information. Results indicated that judged effort decreased as the level of ability increased for all ages. Even kindergarteners judged ability to be an inverse function of effort, though they had more difficulty judging effort as an inverse function of ability.

In another study, Wimmer et al. (1982) asked children ages 4, 6, and 8 to infer effort, ability, or outcome level for a single character from information about the other two factors, and found that 4-year-olds got over 80% of the causal inferences "correct" (e.g., inferred higher ability when the character put forth less effort and the outcome remained the same) for all three types of judgments (effort, ability, and outcome), with older children getting even higher percentages correct. Another study found that young children could reason about effort and ability in mature ways when interpreting feedback from adults. Schunk (1983) found that when third grade children were given feedback about their effort and/or ability on a task, they related the effort feedback negatively to their ability. These four studies suggest that aspects of the developmental shift in reasoning about effort and ability occur *earlier* than Nicholls' (1978) theory predicts.

An additional study by Harari and Covington (1981) suggests that an understanding of the relation between amount of effort and ability may not occur until *later* than the theory predicts. Specifically, children may not fully understand the inverse relation between effort and ability until after the age (11 or 12) originally specified by Nicholls (1978). In this study, participants were given hypothetical scenarios about students who had different levels of effort, ability, and outcome. Students in grade 6 endorsed a positive relation between ability and amount of effort, students in grade 11 endorsed a negative relation between ability and amount of effort, and students in grade 8 were somewhere in the middle. Thus, Harari and Covington concluded that “adult-like” beliefs about the relation between quantity of effort, ability, and outcome do not occur until at least 13-14 years of age.

Why is there so much disagreement within the literature as to when developmental shifts about the reasoning about effort and ability occur? One possible explanation is that studies differed greatly on the methodology they used. Several of the studies that found that very young children understand the inverse relation between quantity of effort and ability used specific precautions to ensure that the younger children understood the task. For example, Karabenick and Heller (1976) gave information verbally to participants in a cascading pattern: they first gave participants outcome information and had them make an effort or ability evaluation, then they provided effort or ability information and allowed them to change their initial evaluation. This way of designing the task would give young children time to think about and process each new piece of information individually. Surber (1980) and Wimmer et al. (1982) also used strategies to ensure that their participants understood the task, such as interviewing the young children individually, using a lot of pictorial or visual imagery, frequently asking the children to describe the stimuli in order to check their understanding, and giving additional prompts and help if necessary. Perhaps younger children in these studies better understood the tasks and therefore were able to perform similarly to the older children in other studies. In addition, there were several other factors that could have contributed to differences between studies, including domain (academic vs. non-academic), measures (e.g., vignettes, videotapes, more “real-life” scenarios where participants actually completed tasks), and sample (e.g., the samples were fairly small overall and were recruited from around the world).

In summary, the studies described above support Nicholls' (1978) claim that most individuals eventually develop a conception of quantity of effort and ability as inversely related to one another with respect to outcome (i.e., when the outcome is held constant, more effort is indicative of lower ability). However, it is possible that the shift in the sophistication of reasoning about effort and ability may occur earlier or later than Nicholls' (1978) predictions, depending on the context. Although the studies above do not all agree on the specific ages at which that these conceptions arise, they do agree that, by adulthood, most people understand and can fairly consistently use the inverse compensation rule when evaluating ability based on information about the quantity of effort.

Importantly, just because mature individuals are *able* to view amount of effort and ability as inversely related does not necessarily mean that they will do so in every context. In the second component of Nicholls' (1984) theory, he suggests that there are specific features of achievement situations that can change individuals' conceptions of ability, and thus their perception of the relation between quantity of effort and ability. In situations where individuals are seeking to demonstrate or assess normative levels of ability and that are typically characterized by an emphasis on social comparison and competition (i.e., *ego-involved* situations), individuals tend to employ what Nicholls (1984) calls a "differentiated" conception of ability, where ability is seen as a capacity and is judged relative to one's peers. In these situations, individuals view high effort as an indication that one lacks ability, which is consistent with the belief that quantity of effort and ability are inversely related to one another: the more effort or time someone needs to learn something, the lower their capacity. Therefore, under these conditions, individuals are likely to perceive a negative relation between quantity of effort and ability. However, in situations that are focused on increasing mastery or competence, and where there is less of a social or external perspective on the self (i.e., *task-involved* situations), individuals of different ages often employ an "undifferentiated" conception of ability, defining ability in terms of changes in one's competence due to effort. In these situations, individuals view the attainment of mastery as an end in itself, and thus perceive the relation between amount of effort and ability positively: more effort will lead to more learning, and thus, higher ability.

It is worth noting that this component of Nicholls' (1984) theory is conceptually similar to modern goal orientation theory (see Kaplan & Maehr, 2006, for a review) in that ego-involved situations are associated with the goals of outperforming others and exhibiting normative level of competence (i.e., performance goals), while task-involved situations are associated with the goals of developing one's knowledge and skills (i.e., mastery or learning goals; Nicholls, 1984). However, although a number of studies have linked students' perceptions of a mastery classroom goal structure to the belief that effort is *more* important than ability for success (e.g., Ames & Ames, 1981; Ames & Archer, 1988; Thorkildsen & Nicholls, 1998), no studies that I know of have directly examined how classroom goal structures are related to students' conceptualizations of the *relation* between effort and ability within a particular classroom.

This second component of Nicholls' (1984) theory also has empirical support. In a series of studies conducted by Jagacinski and Nicholls (1984), college students were asked to imagine themselves in a hypothetical task-involved or ego-involved scenario where they put forth either high or low effort, and then asked to rate their competence using a single item. Results showed that in the ego-involving conditions (e.g., studying Italian in order to become an Italian professor, a job with a scarcity of positions available), less effort was associated with higher competence ratings, whereas in task-involving conditions (e.g., studying Italian due to a love of the Italian culture and interest in the language), more effort was associated with higher competence ratings.

Another series of studies conducted by Jagacinski and Nicholls (1987) sought to disentangle the influence of social comparison information from task/ego involvement on individuals' conceptions of ability. College students were asked to imagine themselves in either a task-involved or ego-involved situation and then were either given social comparison information or not (Study 1 manipulated this between-subjects and Study 2 within-subjects). They found that, across both task-involved and ego-involved situations, an emphasis on social comparison information shifted students' conceptions of ability. In the absence of social comparison information, higher effort on a task was associated with greater feelings of competence in college students. However, once social comparison information was emphasized (e.g., when students were told, "Other people did not find [the task] challenging and needed much less effort than you did"), students associated higher effort on a task with *less* competence. Although this pattern was found in both task-involving and ego-involving contexts, it was stronger in ego-involving contexts. Overall, these studies show that aspects of the situation (i.e., whether task-involved, ego involved, or emphasizing or de-emphasizing social comparison information) can influence one's perception of the relation between amount of effort and ability.

Additional evidence for competition and social comparison as cues for thinking in terms of an inverse relation between effort and ability comes from the developmental studies reviewed in the previous section. For instance, many of the studies in which students of different ages endorsed an inverse relation between effort and ability were situated within competitive contexts (e.g., Droege & Stipek, 1993; Graham & Barker, 1990; Harari & Covington, 1981; Karabenick & Heller, 1976; Kun et al., 1974; Kun, 1977; Miller, 1985; Surber, 1980; Wimmer et al., 1982).

In summary, Nicholls' (1978, 1984) theory of ability conceptions helps explain how individuals think about relations between effort and ability. His theory consists of two main components. The first, a developmental component, focuses on how children grow in their understanding of how to conceptualize ability and how to use effort and outcome information to form ability evaluations. Although Nicholls' (1978) developmental levels are generally supported by empirical research, extant research provides mixed evidence about the exact timeline for when children begin to understand the "differentiated" conception of ability that is inversely related to amount of effort. In the second component, Nicholls (1984) extends the first by trying to understand why older children and adults, once they are able to conceptualize ability as either differentiated or undifferentiated from effort, might hold different conceptions of ability in different situations. He specifically focuses on how situational factors can influence individuals' perceptions of the relation between quantity of effort and ability: in ego-involved situations where social comparison and competition is salient, more effort may be indicative of lower "differentiated" ability (i.e., inverse relation), whereas in task-involved situations where the focus in on individual growth, more effort may be a sign of higher "undifferentiated" ability (i.e., positive relation). This component of Nicholls' (1984) theory is also supported by empirical work and suggests that situational cues are important determinants of how individuals might think about effort and ability within a particular context. Overall, Nicholls' (1978, 1984) theory helps us understand how individuals perceive the relation between effort and ability developmentally and in different contexts or situations.

Dweck's Theory of Individual Differences in Beliefs about Intellectual Ability

In addition to situational factors, there are also somewhat stable individual differences that affect the way people view the relation between quantity of effort and ability. As discussed in Chapter 1, Carol Dweck has shown that one important individual difference is people's lay theories or naïve beliefs about intellectual ability (e.g., Dweck & Molden, 2005). Before discussing Dweck's work in more detail, it is worth commenting on differences between Nicholls' (1984) and Dweck's (1999; Dweck & Master, 2009) use of terminology. Nicholls made a conceptual distinction between "ability" and "intelligence", such that the term "intelligence" naturally presumes a conception of ability as a capacity that is differentiated from effort, while "ability" refers to something that can be conceptualized in multiple ways (i.e., as differentiated or undifferentiated from effort; see Nicholls, Patashnick, & Mettatal, 1986). Dweck, however, used the terms "intelligence" and "ability" somewhat interchangeably (e.g., Dweck, 2002); thus, for the purposes of this review paper, we will discuss Dweck's (1999; Dweck & Leggett, 1988; Dweck & Master, 2009) theory using the term *ability*, rather than intelligence, to be consistent with Nicholls' terminology and because Dweck used the term frequently when discussing her own theory. However, it is important to note that concerns have been expressed in the literature about whether or not the two terms meaningfully differ from one another.

Dweck (1999; Dweck & Master, 2009) posits that individuals who believe that intellectual ability is fixed and unchanging (i.e., entity theorists) tend to believe that no amount of effort will change one's ability, and that, in fact, putting a lot of effort into a task might indicate that one *lacks* ability. Thus, they are likely to perceive amount of effort as *inversely* related to ability. Conversely, those who believe that intellectual ability is malleable (i.e., incremental theorists) tend to believe that increased effort leads to improvement and mastery. Thus, they are likely to perceive amount of effort as *positively* related to ability.

A number of researchers found that the perceived relation between effort and ability depends in part on people's implicit lay theories or naïve beliefs about intellectual ability. One study by Mueller and Dweck (1997; as cited in Dweck, 1999) found that college students who held an entity theory (i.e., those scoring one standard deviation above the mean on a measure of implicit theories) were likely to agree with statements such as, "I sometimes feel that the more effort you have to put into your school assignments, the less intelligent you probably are." In other words, having to put forth a lot of effort is an indication that one has low intellectual ability, whereas putting forth little effort is an indication that one has high ability. Incremental theorists (i.e., those scoring one standard deviation below the mean on a measure of implicit theories) were more likely to disagree with these statements. Miele and Molden (2010) found that college aged entity theorists were more likely to interpret their own experiences of effort as an indication that they were reaching the limits of their ability, whereas incremental theorists were more likely to interpret effort as an indication of increased mastery. In another study (Dweck, 1999), grade school children and college students were asked, "Sometimes students feel smart in school and sometimes they don't. When do you feel smart?" Grade school children with an entity theory said they felt smart "When I turn in my papers first" and college students with an entity theory said they felt smart "When others are struggling, but it's easy for me." In contrast, grade school children with an incremental theory said they felt smart "When I don't know how to do it and it's pretty hard and I figure it out without anybody telling me" and college students with an incremental theory said they felt smart "When I'm working on something I don't understand yet". Overall, these studies suggest that individuals with an entity theory view effort as an indication that one lacks ability, while incremental theorists view effort as having a positive effect on one's ability.

Results of other studies are consistent with these findings. Hong et al. (1999) explored the relation between implicit theories (measured with a questionnaire) and attributions for failure in three studies. The studies found that undergraduate incremental theorists put greater weight on effort than entity theorists when seeking causal explanations for failure on a task, and were more likely to take a remedial course to improve their skills when they realized their performance was unsatisfactory than were entity theorists. Of particular relevance to the present discussion, participants in Study 3 were also given a hypothetical scenario and asked which of two students was more intelligent: Student A, who ranked first in the class and was diligent, or Student B, who ranked tenth in the class but only studied before the test. Participants who were induced to temporarily adopt an entity theory were more likely to name Student B as the more intelligent student than participants who were induced to adopt an incremental theory, suggesting that entity theorists perceive relatively low levels of effort to be indicative of high levels of intellectual ability.

Blackwell, Trzesniewski, and Dweck (2007) examined early adolescents' implicit theories of intelligence in a longitudinal study. They followed four waves of students as they progressed from seventh to eighth grade. Blackwell et al. (2007) found that an incremental theory of intelligence was associated with learning (as opposed to performance) goals, positive effort beliefs (e.g., "the harder you work at something, the better you will be at it"), and positive effort strategies. Also, students who endorsed an incremental theory of intelligence had a better grade trajectory over the course of junior high than those who endorsed an entity theory, controlling for prior achievement. These results suggest that an incremental theory of intelligence is associated with a belief that effort is positive and helpful, rather than an indicator of low ability, and that holding an incremental theory is associated with positive achievement outcomes (see also Jones, Wilkins, Long, & Wang, 2012; Miele, Son, & Metcalfe, 2013).

It is important to note that individuals' theories of intelligence not only appear to influence how they conceive of the relation between effort and ability, but also how they evaluate the *level* of their *own* abilities in certain situations. Dweck and Leggett (1988) argue that individuals' theories of intelligence interact with their beliefs about the level of their own abilities to predict behavioral outcomes. Specifically, they suggest that entity theorists who believe they have *high* ability will often display a mastery pattern of behavior when confronting challenges, whereas entity theorists who believe they have *low* ability will often display a helpless pattern of behavior. Incremental theorists, on the other hand, will display a mastery pattern of behavior whether they believe they have high *or* low ability. Thus, beliefs about the *nature* of ability and beliefs about the *level* of one's own ability are different constructs and interact to predict motivational behaviors.

However, there is also evidence that individuals' theories of intelligence (or, how they conceive of the *relation* between effort and ability) directly predict how they evaluate the *level* of their own abilities, especially in contexts where they exert high effort. Many studies have demonstrated that individuals with an entity theory tend to evaluate their own abilities negatively when they exert high effort, but that individuals with an incremental theory tend *not* to evaluate their own abilities negatively when they exert high effort (e.g., Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988). This, at the very least, suggests that conceiving of an *inverse* relation between effort and ability can influence individuals' beliefs about their own abilities when they exert high effort. In addition, to the extent that incremental theorists believe that effort increases their competence or mastery on a task, and that ability can be defined in terms of competence and mastery (e.g., Dweck, 1999), it would make sense that incremental theorists (or, those who conceive of a *positive* relation between effort and ability) would evaluate the *level* of their own abilities higher when they exert high effort. Thus, how individuals conceive of the relation between effort and ability appears to be tied to how they evaluate the levels of their own abilities.

As a whole, these studies provide support for Dweck's (1999; Dweck & Master, 2009) theory of individual differences in beliefs about intellectual ability, and can help account for both positive and negative relations between perceived amount of effort and ability. Individuals who believe that ability is fixed and unchanging tend to view effort and ability as being inversely related because they conceptualize ability as an innate capacity, while those who believe ability is malleable tend to view effort and ability as positively related because they conceptualize ability as consisting of skills or competencies that can change over time.

How do these theories develop? Dweck and colleagues (e.g., Mueller & Dweck, 1998; Cimpian, Arce, Markman, & Dweck, 2007; Gunderson, Gripshover, Romero, Dweck, Golden-Meadow, & Levine, 2013) suggest that children's implicit theories about ability develop based on the feedback they receive from adults, such as parents or teachers. For example, when children are given feedback (i.e., praise or criticism) about "person" traits, such as their ability (e.g., "You're smart"), it can lead to a belief that their ability is fixed and that effort is futile. As a result of this, they may display helpless behavior when encountering failure, which is consistent with an entity theory. However, when children are given "process" feedback about their effort (e.g., "You worked hard"), they may display mastery behavior in response to failure, which is consistent with an incremental theory. In addition to praise and criticism, adults may also explicitly communicate their own theories of ability to children. These experiences may lead to the development of a somewhat stable entity or incremental theory.

Unresolved Questions

It is important to point out some unresolved questions about the extent to which contextual and/or individual difference factors predict how students perceive the relation between effort and ability in particular situations. In some studies, almost *all* cognitively mature individuals view effort and ability as being inversely related. For example, in Karabenick and Heller (1976), 94% of the low effort characters were chosen as being more able among college students, and in Nicholls (1978), 75% of 13-year olds had reached Level 4 of reasoning about effort and ability (i.e., relating effort and ability inversely). Thus, regardless of any individual differences in students' theories of intelligence, almost all of these participants endorsed an inverse relation between effort and ability. However, in other studies, individual differences in students' theories of intelligence do affect how they view the relation between effort and ability, despite being situated in ego-involved contexts (e.g., Blackwell et al., 2007; Hong et al., 1999). This raises the question of what circumstances lead to situational cues taking precedence over individual difference factors and vice versa.

One possible answer has to do with methodological differences between the studies discussed in the sections on developmental and contextual factors and those discussed in this section on individual differences. For instance, in studies where participants were asked to compare the abilities of two characters who had put forth different amount of effort (Folmer et al., 2008; Nicholls, 1978), these characters were always described as doing equally well on the task. The individual difference study by Hong et al. (1999) used a similar paradigm; however, the character who put forth more effort was described as having slightly better grades than the character who put forth less effort. Thus, when the performance of two students is equated, participants tend to assume that the person who put forth less effort has more ability, and thus perceive an inverse relation between effort and ability. But, when the harder working student is described as having performed *better* than the other student, participants may wonder whether the student who worked less hard would have performed better or only the same as the first student had he or she worked just as hard. When facing this type of ambiguity, participants may be more likely to rely on their general (i.e., situation-independent) beliefs about the nature of ability and, thus, equally likely to think in terms of an inverse or positive relation between levels of effort and ability.

Another possibility is that there were differences in the timing of the study designs. In the developmental studies by Nicholls and others (Folmer et al., 2008; Nicholls, 1978), participants were asked to evaluate the abilities of two students who had put forth different levels of effort on a particular task at a single point in time. In the individual difference study by Dweck and colleagues (Hong et al., 1999), participants were asked to evaluate the abilities of two students who put different levels of effort into studying for a test over the span of months. Thus, the reason why nearly all of the older students in Nicholls' (1978) study (including the incremental theorists presumably) identified the harder working student as having less ability may be because they viewed the students' intellectual capacities as being stable over such a short period of time. In contrast, the reason that incremental theorists in the Hong et al. (1999) study identified the harder working student as having more ability may be because they viewed the students' capacities as susceptible to change over relatively long periods of time.

However, all of these possibilities are based on the assumption made by both Nicholls (1984) and Dweck (1999; Dweck & Master, 2009) that people's conceptions of *ability* (i.e., whether differentiated/undifferentiated or entity/incremental) always dictate the perceived relation between amount of effort and ability. It is important to consider that there may be additional factors beyond individuals' conceptions of ability that influence how individuals perceive the relation between effort and ability, such as individuals' perceptions of the source of *effort*. Although many of the studies discussed above examined how information about the quantity or amount of effort elicited during a task influence ability evaluations, none of the studies examined the perceived *source* of that effort.

For example, individuals who believe that the effort a student expended on a task was primarily elicited by the subjective difficulty of the task may be likely to perceive this effort as being inversely related to her ability (e.g., she *had* to work hard on the task because it was difficult for her, and therefore she must not have high ability), even if they previously held an undifferentiated or incremental conception of ability. That is, most incremental theorists are likely to acknowledge that although ability eventually increases with effort, a student with relatively low levels of *current* ability will need to put more effort into a task right now in order to achieve the same result as a student with relatively high levels of current ability (see Muenks & Miele, 2016).

On the other hand, individuals who believe that the effort a student expended on a task was primarily self-initiated may be likely to perceive this effort as positively related to her ability on that task (e.g., she *chose* to work hard on this task to improve her ability), even if they previously held a differentiated or entity conception of ability. That is, as will be discussed in more detail below, certain effort-related cues might temporarily shift entity theorists from thinking of ability as an innate capacity to thinking of ability in terms of a set of skills that emerges from this capacity and that can be improved (even if the underlying capacity is fixed).

In conclusion, Nicholls (1978, 1984) and Dweck's (1999; Dweck & Master, 2009) theories help us understand why individuals may perceive amount of effort and ability as either positively or inversely related. Both theorists posit that individuals' conceptions of ability influence perceptions of the effort-ability relation. However, Nicholls focuses on developmental and situational predictors of ability conceptions, whereas Dweck focuses on individual difference predictors. Neither theory, however, fully predicts how individuals will perceive the effort-ability relation in any given context. Thus, the theories leave room for aspects of effort, such as the *source* of one's effort, to influence students' perceptions.

Two Perceptions of the Source of Effort: Extending the Theories

In addition to different conceptions of ability, individuals may also hold different beliefs about what drives their own or another person's effort. This gets to the heart of what individuals believe about why they (or another person) works hard, which may have important implications for how they evaluate their own or another's academic ability. As discussed in Chapter 1, the present studies will examine what I refer to as individuals' perceptions of the *source* of effort.

I propose that, within any given achievement-related situation, there are two primary ways that one can perceive the source of their own or another's effort: as task-elicited (i.e., arising from the subjective ease or difficulty of the task at hand) or self-initiated (i.e., arising from the individual's own motivation). Note that when I refer to "task-elicited" effort I do not mean effort that is driven by the objective difficulty of a task, but by the subjective difficulty of a task that is determined by an individual (e.g., that math homework is difficult *for him*). Additionally, "self-initiated" effort encompasses all the reasons students may be motivated to engage in a task, including individual, social, or cultural reasons (e.g., being motivated because students are interested in the task, because they have set goals, because they want to please their teachers, etc.). Although it is certainly possible that effort on academic tasks may, in actuality, be both task-elicited and self-initiated simultaneously, I am interested in examining one's *perceptions* of which of these two sources *primarily* drives their own or others' effort in a particular achievement situation. It is possible that perceptions of relative emphasis of these two sources within a particular achievement situation might influence how one relates amount of effort to ability in themselves or others. These two sources of effort are therefore crucial to consider because they may help to provide a more complete picture of how ability evaluations are formed, rather than just focusing on quantity of effort. The choice to focus on these two particular sources of effort was inspired by work by Koriat et al. (2006) in the cognitive psychology literature, which will be explained next.

In a seminal series of studies within cognitive psychology, Koriat et al. (2006) examined participants' effort (operationalized as study time) during memorization tasks completed either under time pressure or no time pressure. They found that effort could serve one of two functions: Either as a behavioral tool to improve task performance, or as an indicator of how much one had learned. When effort was used a tool to improve performance, the researchers called it *goal-driven* effort: participants chose to regulate their behavior by spending more time memorizing the more difficult words. For Koriat et al. the term "goal-driven" does not refer to a specific motivation or goal, but more broadly to effort that is self-initiated by the individual. A number of studies have demonstrated the goal-driven function of effort or study time (e.g., Mazzoni & Cornoldi, 1993; Dunlosky & Thiede, 1998) and shown that individuals often chose to spend more time on certain tasks or items in order to facilitate their own learning.

Koriat et al. (2006) also showed that effort could be used as an indicator of how much one had learned. That is, individuals sometimes formed metacognitive assessments of learning *based on* the amount of effort they spent on a particular task or item. Koriat et al. (2006) described this kind of allocation of study time as *data-driven* rather than goal-driven. Individuals spent as much time as necessary on a given task or item. Then, if they *had* to spend a long time memorizing a particular word, they concluded that the word was difficult and therefore less likely to be recalled than another word that did not require much time to memorize. Effort or study time was therefore elicited by the task, and was not used as a strategic tool, but as an indicator of how much one had learned.

Several studies have found evidence for both of these functions of effort. For example, Koriat et al. (2006) examined how judgments of learning (JOLs; i.e., judgments about what one knows or how much one has learned) for a word memorization task depend on whether effort was data-driven or goal-driven. Judgments of learning were measured with a single item asking participants what they thought their chances of recalling the word were (between 0%-100%). Koriat et al. (2006) found that the type of effort participants exerted was a function of the conditions of the task. In a self-paced learning scenario with no time pressure, the longer a participant spent studying a word (e.g., the more effort they put into the task), the *lower* the JOL, suggesting that effort was used as an indicator to the participant that the word was difficult (i.e., data-driven effort; see also Hertzog, Dunlosky, Robinson, & Kidder, 2003; Kelley & Jacoby, 1996). However, under time pressure, participants strategically regulated their effort in order to achieve their task goals. Thus, effort became goal-driven—the longer the participant spent studying a word, the *higher* the JOL. Participants in this condition believed they were more likely to recall the words they spent more time on.

In sum, increases in effort can lead to either higher or lower JOLs depending on the time pressure component of the task. In self-paced tasks with no time pressure, participants believed they had learned *less* after putting forth high effort than after putting forth low effort (consistent with data-driven effort). In tasks that involved time pressure, participants believed they had learned *more* after putting forth high effort (consistent with goal-driven effort). In other words, high amounts of effort could either be linked to *negative* evaluations of how much one has learned, or *positive* evaluations of how much one has learned, depending on the timing conditions of the task. Taken together, these findings indicate that high levels of effort can lead to different metacognitive outcomes (see also Koriat & Nussinson, 2009).

The studies described above all utilized samples of college participants. However, there has been some more recent work on the development of these concepts of data-driven and goal-driven effort in young children and adolescents. A study by Koriat, Ackerman, Lockl, and Schneider (2009) found that children were not responsive to data-driven regulation until around the third grade. In a self-paced learning scenario, which should evoke data-driven effort, the JOLs of the older children (third through sixth grade) decreased with increased study time, which is consistent with what Koriat et al. (2006) found with adults. The JOLs of the younger children (first and second grade) did not. However, when examining actual performance, children in all age groups did in fact perform worse on items they spent longer studying. This suggests that the JOLs of the younger children were not accurate. Interestingly, despite the fact that children performed worse with increased study time, a self-report measure showed children of *all* ages (first through sixth grade) believed performance should actually *increase* with increased study time. Koriat et al. (2009) suggest that this implies that children understand the implications of goal-driven effort prior to understanding data-driven effort. Additionally, Koriat, Ackerman, Adiv, Lockl, and Schneider (2014) found that although children in fifth and sixth grade appeared to be responsive to both data-driven and goal-driven effort in different tasks, they were not responsive to *both* types of effort in the same task, while ninth grade students and adults were. These findings suggest that children become more sophisticated in the sensitivity of their JOLs to both data-driven and goal-driven effort over time.

As a whole, these studies provide support for these two different functions of effort: as an indicator of how much one has learned (data-driven effort) and as a tool to regulate learning (goal-driven effort). However, it is important to note that in Koriat et al. (2006) it is unclear whether participants were aware that their effort was data-driven or goal-driven. In later studies, Koriat and colleagues (Koriat & Nussinson, 2009; Koriat, Nussinson, & Ackerman, 2014) attempted to examine whether participants' *attributions* of their effort to data-driven or goal-driven regulation influenced their JOLs. Koriat and Nussinson (2009) found that in self-paced tasks, participants who were asked to contract the corrugator muscle in their forehead (which makes individuals feel like they are exerting high effort) while memorizing word pairs had lower JOLs than participants in the control condition. In tasks with time pressure, participants who were asked to contract the corrugator muscle had *higher* JOLs than participants in the control condition. Thus, whether participants attributed the effort associated with contracting the corrugator muscle to data-driven or goal-driven sources impacted their JOLs. Koriat et al. (2014) also found that individuals' interpretations of whether their effort was data-driven or goal-driven moderated the relation between study time and JOLs, as well as between effort ratings and JOLs. This pattern was found when participants were asked to monitor their own learning, as well as when they were asked to monitor another student's learning. These studies provide evidence for an attribution process whereby individuals' experiences of effort influence their judgments of learning.

Although Koriat and colleagues' (2006, 2009) work provides a general conceptual framework for how I define sources of effort, I extended this work by examining students' self-evaluations about ability rather than their JOLs. I also did not want to use the term goal-driven as it may overlap with the way goals are typically defined in the achievement motivation literature (Kaplan & Maehr, 2006). Thus, I used slightly different terminology from Koriat et al. (2006) that is more consistent with the aims of the present studies. In the present dissertation studies, as discussed earlier, I used the terms *task-elicited* effort (i.e., effort that is perceived as arising from the task itself) instead of data-driven, and *self-initiated* effort (i.e., effort that is perceived as arising from one's own drive or motivation) instead of goal-driven.

Because the studies mentioned above all examined how data-driven and goal-driven effort relate to metacognitive judgments of learning on specific tasks (Koriat et al., 2006; Koriat et al., 2009; Koriat et al., 2014), it seems reasonable that perceptions task-elicited and self-initiated effort may influence more global evaluations of one's academic ability. If individuals perceive that their effort was primarily internally driven (i.e., effort was self-initiated), they might conceptualize ability as a set of skills and expect the relation between their effort and ability to be positive. This is because putting forth a lot of effort on an academic task would be interpreted as a sign that one is highly motivated to improve his or her ability, while exerting little effort on an academic task would be a sign that one is not very motivated to improve his or her ability. On the other hand, if people perceive that their effort was primarily elicited externally by the subjective difficulty of the *task* (i.e., was task-elicited), they might conceptualize ability as a fixed capacity and predict an inverse relation between their effort and ability. That is, the harder one *has* to work to complete a task, the lower his or her ability, and the easier one finds a task, the higher his or her ability. Thus, it might be important to consider how someone perceives the source of their own or another's effort in order to understand the way in which that person relates effort information to ability information in an achievement scenario.

For example, say that a student named Rebecca is in her tenth-grade English classroom and is working on an in-class writing assignment on *Hamlet*. She is old enough from a developmental perspective to understand the difference between the concepts of effort and ability (Nicholls, 1978). She also knows that this assignment is going to be graded and that her work will be compared against the work of other students in her class. Thus, she is part of an ego-involving situation characterized by social comparison (Nicholls, 1984). Rebecca notices that her classmate Adam, who is sitting right next to her, appears to be working very hard on the assignment, while Rebecca does not feel that she is working very hard. The next day, the class receives their grades on the assignment: Rebecca and Adam both receive an 85%. How will Rebecca perceive Adam's ability compared to her own?

In this scenario, Nicholls (1984) may predict that, because the situation is ego involving, Rebecca would hold a differentiated conception of ability and perceive Adam as having lower ability than her, since Adam had to work harder to reach the same outcome. Dweck (1999; Dweck & Master, 2009) may predict that Rebecca's implicit theory of ability would determine how she perceived Adam's ability: if Rebecca held an entity theory, she would likely perceive Adam's ability as lower than hers, but if she held an incremental theory, she would likely *not* perceive Adam's ability as lower than hers.

However, I argue that Rebecca's assessment of Adam's ability also depends on what she perceived the *source* of Adam's effort to be. If Rebecca perceived Adam's effort as primarily being elicited by his perceptions of the difficulty of the task (i.e., task-elicited), then Rebecca might perceive Adam as having lower ability because he had to work harder to receive the same grade as Rebecca. However, if Rebecca perceived Adam's high levels of effort as primarily arising from Adam's motivation (i.e., self-initiated), perhaps a personal interest in the story of *Hamlet*, she might *not* perceive Adam as having lower ability than herself, even within the context of an ego-involved achievement situation. Thus, Rebecca's evaluation of Adam's ability will depend on her perception of the source of his effort.

Importantly, cues about the sources of effort may temporarily alter the way that individuals define ability. In Dweck's (1999; Dweck & Master, 2009) theoretical approach, entity theorists tend to conceptualize ability as an innate capacity, whereas incremental theorists are more likely to think of ability as a learned set of skills. However, both entity and incremental theorists *can* conceptualize ability in both ways and may shift the way that they think about it if strong situational cues are present. The example with Rebecca above suggests that even though the ego-involved nature of the situation or her own implicit entity theory may encourage her to think about ability as a capacity, salient cues about the intentions behind Adam's effort may shift her into thinking about ability as a set of skills. Source of effort cues are therefore important factors that may influence how individuals conceptualize the relation between amount of effort and ability, and may be independent from information about the nature of the achievement situation or individuals' own implicit theories of intellectual ability.

As another example, say that a high school student named Emily, who is typically an entity theorist, notices that her friend, Sarah, works really hard on a set of math problems that the teacher assigned. If Emily perceives that Sarah is working hard because she is really motivated to learn, rather than because the task is difficult for her, Emily's definition of ability may shift into one that focuses on skills or competencies rather than innate talent. She therefore may not perceive that Sarah's ability is low just because she is working hard. On the other hand, say that another student, John, is typically an incremental theorist but he perceives that his friend Eric works really hard on his math problems because they are very challenging for him. Although John would usually define ability as a set of skills that can be improved, information about Eric's apparent difficulty with the task may shift him into thinking about ability as a capacity, and thus conclude that Eric's hard work indicates a lack of ability. It therefore seems possible that cues about the source of effort could at least temporarily change one's conceptualizations of ability.

Understanding how students make these evaluations of their own and others' abilities is important because these evaluations can affect students' motivation. For example, if students work hard *and* perceive their own effort as task-elicited (as opposed to self-initiated), they may evaluate their own ability negatively, which could decrease their motivation in school. Similarly, if students perceive others' apparent lack of effort as due to their feelings of ease with the task as opposed to due to a lack of motivation to learn, they may evaluate their peers' abilities more highly and their own ability more negatively by comparison, which may also decrease their motivation in school. It is therefore important to understand how perceptions about the source of effort in others might influence students' beliefs about themselves.

Evidence for the Distinction Between Task-Elicited and Self-Initiated Effort

Only a few very recent studies (that will be discussed below) have specifically examined the impact of task-elicited and self-initiated effort cues on students' ability evaluations. However, work by Gail Heyman and colleagues (Heyman et al., 2003; Heyman & Compton, 2006) paved the way for this research by demonstrating that young children's ability evaluations of hypothetical characters are sensitive to cues about effort. These findings underscore the possibility that perceptions about the type of effort exerted may influence how individuals relate quantity of effort to ability.

Heyman et al. (2003) examined children's reasoning about effort, ability, and outcome. The researchers studied whether young children's ability evaluations were sensitive to two types of information: perceived difficulty information ("thought the puzzle was easy/hard to do") and effort information ("tried hard/did not try hard"). In Studies 1 and 2, Heyman et al. (2003) asked 3-5 year old children (M_{age} in Study 1 = 4.58 years; Study 2 = 5.17 years) to respond to hypothetical scenarios about two characters completing a puzzle. In the perceived difficulty condition, they told participants: "Kayla finished the puzzle. Jennifer also finished the puzzle. Kayla thought the puzzle was easy to do, but Jennifer thought the puzzle was hard to do. Do you think one of them is smarter?" In the "effort" condition, they gave participants effort (high or low) and outcome (good or bad) information. For example, in the scenario involving high effort and bad outcome, participants were told: "Eva tried really hard on her schoolwork and got everything wrong. How smart is Eva?" Results showed that, in the perceived difficulty conditions, participants believed that the character who thought the puzzle was easy to do was smarter than the character who thought the puzzle was hard to do. The effort condition results differed across the two studies. In Study 1, there was no main effect of effort, but in Study 2, which was run with a higher-SES sample of participants, there was a main effect of effort: participants inferred that the character who tried hard was *smarter* than the character who did not try hard. Results from Studies 1 and 2 suggest that preschool-aged children believe that thinking a task is difficult means you are not very smart, but working hard means that you *are* smart. In other words, thinking about effort differently (as it relates to task difficulty vs. working hard in general) influenced children's ability evaluations of the characters.

Study 3 involved a sample of 3-5 year old children (M_{age} = 4.75 years) as well as an older sample of 9-10 year old children (M_{age} = 9.83 years). The tasks were the same as in the first two studies. Again, researchers found that participants of all ages believed the character that thought the puzzle was easy to do was smarter than the character that thought the puzzle was hard to do. Additionally, when asked to infer ability given effort and outcome information, both the younger and older children believed that characters who tried hard were smarter than characters that did not try hard, endorsing a positive relation between amount of effort and ability.

Overall, results from these three studies suggest that children are sensitive to information about effort. Heyman et al. (2003) attempted to explain these results by discussing the possibility of a *dual schema hypothesis*. They argued that, when task difficulty information (e.g., the difficulty of the puzzle as perceived by the character) was provided, a *perceived difficulty schema* was activated, and children believed that the character who thought the task was difficult was not as smart as the character who thought the task was easy. In contrast, when effort information (e.g., how hard the character tried) was provided, an *effort schema* was activated, and children believed that the character who tried harder was smarter than the character who did not try as hard. Another way to interpret these results is that, when given perceived difficulty information, children thought about task-elicited effort, whereas when they were given effort information, they thought about self-initiated effort. It is important to note, however, that Heyman et al. (2003) did not give any explicit instructions that the effort was self-initiated in the effort condition; children were simply told, for example, “Eva tried really hard” or “Eva did not try very hard.”

Although the concepts of task-elicited and self-initiated effort do not align perfectly with the perceived difficulty and effort constructs in Heyman et al. (2003), this pattern of results does suggest that effort-related cues can lead participants to interpret effort information in different ways, and these interpretations influence how they form ability evaluations. However, it could be argued that the young children in this study were not thinking about effort per se when they thought about what makes a task "easy" or "difficult," but had simply encoded the belief that smart people can solve easy and difficult problems, whereas people who are not smart can only solve easy problems. The next set of studies manipulated children's perceptions of the source of effort more directly with samples of older children.

In Study 1 of Heyman and Compton (2006), 5-10 year old children judged the ability of two different characters in a hypothetical scenario. Unlike in the previous studies, the characters in this scenario always differed in terms of how much effort they actually expended on the task, not just in terms of how they perceived the task. One of the characters was said to have finished a set of puzzles very quickly, while the other character finished the puzzles slowly. This difference in puzzle-solving effort was framed differently depending on whether participants were in the *effort*, *perceived difficulty*, or *no prime* condition. In the *effort* condition, participants were told that the slow character "tried and tried" and the fast character "hardly tried at all". In the *perceived difficulty* condition, participants were told that the slow character "thought the puzzles were hard to do" and the fast character "thought the puzzles were easy to do." In the *no prime* condition, participants were only given information about the speed of completion. Participants were then asked to determine who was smarter using a single item. Results showed that, for the older participants (8-10 year olds; M_{age} = 9.47 years), 72% of participants in the *perceived difficulty* condition identified the faster child as smarter, whereas only 41% in the *effort* condition identified the faster child as smarter. In the *no prime* condition, 50% of participants identified the faster child as smarter. There were no differences between conditions for the younger participants (5-7 year olds; M_{age} = 6.58 years).

In Study 2, which was also conducted with 5-10 year olds, Heyman and Compton (2006) used a slightly modified methodology by including priming information in the form of questions about the characters rather than having the information embedded within the character descriptions. Results showed that for both younger (5-7 year olds; M_{age} = 6.67 years) and older participants (8-10 year olds; M_{age} = 9.42 years), those in the *perceived difficulty* condition were more likely to believe that the faster child was smarter compared to those in the *effort* condition, consistent with Study 1.

Heyman and Compton (2006) then examined whether these cues also influence children's predictions of the character's future performance and their beliefs about the malleability of ability in Study 3. In this study, kindergarten children (M_{age} = 6.08 years) were randomly assigned to either the *effort first* or *perceived difficulty first* condition. All participants were given both scenarios from Study 2 (but in different orders), and were then asked to complete two new dependent measures: one about future performance and the other about the malleability of ability. Results showed that, when asked about a character's future performance, those who were asked the effort question most recently ("Did Elizabeth try hard when she did the puzzle, or not try hard?") believed that the character would perform better in the future and that ability in general was more malleable than those who were asked the perceived difficulty question ("Did Elizabeth think the puzzle was hard to do, or easy to do?") most recently.

As a whole, these studies suggest that contextual effort cues can change the way that children reason about effort and ability. When given perceived difficulty information, children tended to view effort and ability as inversely related and when they were given effort information, they did not necessarily view effort and ability as inversely related. This difference appeared to be more pronounced for the older children than the younger children. However, it is also important to note that researchers disagree about what exactly children understand about distinction between concepts of effort and ability at these ages (e.g., Nicholls, 1978; Karabenick & Heller, 1976; Surber, 1980; Harari & Covington, 1981), so it is difficult to make any strong conclusions about how children in these studies were conceptualizing effort and ability and the relation between them. Again, it is possible that some of children in the effort condition were unable to distinguish between the concepts of effort and ability and thus assumed that high effort meant high ability, while children in the perceived difficulty condition simply used the heuristic that smarter individuals generally feel that problems are easier. In fact, Nicholls and Miller (1983) found that children appear to understand objective task difficulty (i.e., that more difficult tasks demand more ability) prior to normative task difficulty (i.e., understanding that it is better to succeed on a normatively difficult task than an easy one). Children in this study may have used information about objective difficulty to make their ability judgments without fully understanding the inverse relation between effort and ability. Thus, it is possible that some of these children were not yet able to distinguish ability from either effort or task difficulty.

Although there are some developmental concerns about interpreting these results, Heyman and Compton's (2006) work does set the stage for making an argument for the role of task-elicited and self-initiated effort in students' ability evaluations. When perceived difficulty information was given, children may have concluded that the characters worked hard primarily because of the characters' perceptions of the difficulty of the task itself (i.e., task-elicited effort). As the results of Study 3 suggest, this perception of the source of effort may have also primed a conception of ability as an innate capacity. On the other hand, when effort information was given, some children may have shifted into thinking about effort as primarily driven by the character's own motivation (i.e., self-initiated effort), and concluded that the characters who put in lots of effort could still have high ability. This perception of the source of effort may have also primed a definition of ability as a set of skills or competencies that can be improved. However, because task-elicited and self-initiated effort were not explicitly manipulated in these studies, and because there were developmental concerns with participants' understanding of effort and ability, these hypotheses were not tested directly in Heyman and Compton (2006).

To address some of the concerns with the Heyman studies (Heyman et al., 2003; Heyman & Compton, 2006), Muenks et al. (in press) directly manipulated perceptions of effort source and examined its impact on the direction of the relation between amount of effort and ability in samples of college students. In Studies 1a and 1b, participants read a series of hypothetical vignettes in which two characters spent different amounts of time completing an academic task. In the task-elicited condition, effort was attributed to how difficult or easy the character found the task; in the self-initiated condition, effort was attributed to how motivated or unmotivated the character was during the task. Researchers also varied the characters' performance (i.e., the character who spent more time scored higher, lower, or the same as the character who spent less time) and the academic domain of the task (math, English literature, or physics). After reading each vignette participants were asked to evaluate which character's ability was higher.

Study 2 consisted of three separate blocks. In the sequential information block, participants were provided with effort level, effort source, and performance information about a single character in sequential order and made ability judgments about that character after each piece of information was presented. In the concurrent information block, participants were provided effort level, effort source, and performance information about a single character all at once and made an ability judgment about that character after all pieces of information were presented together. In the peer ratings block, participants were asked to imagine a time when a real-life peer either worked hard or slacked off on an academic assignment, and then were asked to imagine that their peer's effort was due to either the difficulty/ease of the task, or the participant's motivation/lack of motivation. They were then asked to evaluate their peer's ability.

Muenks et al. (in press) found across all studies that when effort was described as task-elicited (e.g., arising due to subjective difficulty or ease of the task), participants were more likely to perceive an inverse relation between amount of effort and ability (i.e. high effort reflects low ability). When effort was described as self-initiated (e.g., arising due to motivation or lack of motivation), participants were more likely to perceive a positive relation between amount of effort and ability (i.e., high effort reflects high ability).

Importantly, these patterns were found only in the absence of clear performance outcomes. In other words, when explicit performance information was provided, participants tended to rely heavily on that information when evaluating the characters' abilities and ignore effort source information. Only in conditions in which performance information was not provided did effort source appear to influence participants' ability evaluations. This finding is important because Muenks et al. (in press) were the first to examine students' ability evaluations of hypothetical characters in both the presence and absence of explicit performance information. In previous research, performance information was always provided and appeared to play an important role in students' ability evaluations (e.g., Nicholls, 1978; Nicholls & Miller, 1984; Kun, 1977; Heyman & Compton, 2006). Thus, results from these studies suggest that effort source may be particularly important in achievement situations in which students are not given access to information about others' performance (e.g., grades). In Study 1 of the proposed dissertation studies, I isolated performance information from effort source information in order to examine whether I could replicate the results of Muenks et al. (in press).

As a whole, studies conducted by Muenks et al. (in press) suggest that task-elicited cues lead to an *inverse* relation between amount of effort and ability, whereas self-initiated effort cues lead to a more *positive* relation between effort and ability. This pattern of results was also found when participants were asked to recall achievement situations from their real lives and evaluate the abilities of peers or acquaintances. Thus, it appears that source of effort cues can influence the direction of the relation between effort and ability when college students are asked to make ability evaluations of *other* people. However, as will be discussed in the next section, Muenks et al. (in press) did not examine how cues about task-elicited and self-initiated effort impact students' evaluations of their *own* abilities in school-related contexts, which I did in the present dissertation studies.

In summary, the distinction between task-elicited and self-initiated effort can help extend existing theories about the relations between amount of effort and ability (Nicholls, 1978; Dweck & Master, 2009) by identifying an additional cue that individuals use to understand this relation. In their original form, both theorists seemed to assume that a student's conception of *ability* determined how he or she viewed the relation between amount of effort and ability, although Nicholls (1978) focused on situational predictors of ability conceptions whereas Dweck (1999; Dweck & Master, 2009) focused on individual difference predictors. Specifically, they posited that a differentiated or entity conception of ability will lead people to perceive a negative relation between amount of effort and ability, whereas an undifferentiated or incremental conception of ability will lead them to perceive a positive relation.

However, as previously suggested, it is possible that individuals' conceptions of ability only *predispose* them to interpret effort in a particular manner. Those with a differentiated or entity conception of ability might be predisposed to view effort as task-elicited in most contexts, while those with an undifferentiated or incremental conception of ability might be predisposed to view effort as self-initiated. But it is possible that even when people hold an entity or differentiated conception of ability, if they primarily perceive another person's effort as being internally motivated (e.g., self-initiated), they might shift to a different definition of ability (e.g., ability as a set of skills) and view their effort as positively related to ability. Similarly, even when people hold an incremental or undifferentiated conception of ability, if they primarily perceive another's effort as being elicited by the subjective difficulty of the task (e.g., task-elicited), they might shift to a different definition of ability (e.g., as a capacity) and view the amount of their effort and ability as being inversely related. In other words, conceptions of ability may not always be the primary determinant of how individuals will perceive the relation between amount of effort and ability; perceptions of the *source* of effort are also important, and may vary independently from conceptions of ability. Thus, not only are perceptions of effort source and ability conceptions distinct constructs, but they may influence each other in a bidirectional manner: in some situations ability conceptions may lead to different perceptions of effort source, and in other situations information about effort source may lead to different ability conceptions. Although not tested in the present studies, this bidirectional relation seems theoretically plausible based on previous research. See Figure 1 for a visual depiction of the literature review and theoretical model guiding the present studies.

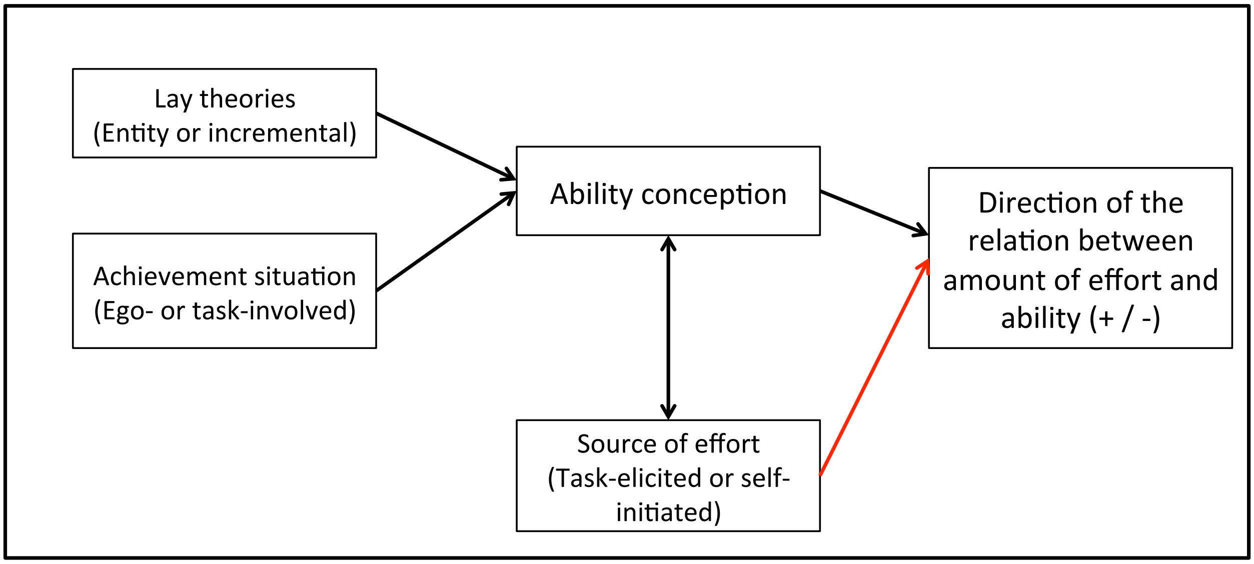

Figure 1. A model of what influences students' perceptions of the relation between effort and ability. This model is situated within a particular achievement situation. The red arrow is what I tested in the present dissertation studies.

It may be useful to identify what types of information shift students' perceptions of effort source because this information may at times override students' conception of ability to influence how they perceive the relation between amount of effort and ability at that moment. For example, verbal, written, or visual cues that indicate that someone is working hard because they feel the task is challenging for them or they are struggling with the task, such as hearing a fellow student discuss how difficult the task is for them, or observing a fellow student get visibly frustrated with the task, might prime students to think in terms of task-elicited effort. Conversely, information that provides insight into someone's motivations or that indicate that someone is working hard because of goals they have set for themselves, because they want to learn or perform well, or because they are particularly interested in or place value on some aspect of the task, might prime students to think in terms of self-initiated effort.

In conclusion, although much of the literature reviewed earlier that empirically tested Nicholls (1978) and Dweck's (Dweck & Master, 2009) theories suggests that students' beliefs about *ability* influence how they perceive the relation between amount of effort and ability, studies by Heyman and colleagues (Heyman et al., 2003; Heyman & Compton, 2006) and Muenks and colleagues (in press) suggest that students' perceptions about the type of *effort* exerted may also influence perceptions of this relation. Adding perceptions of the *source* of effort, a somewhat novel variable to apply to the literature on academic effort and ability, as an extension to both Nicholls (1978, 1984) and Dweck's (Dweck & Master, 2009) theories may provide more targeted and complete predictions of students' evaluations of their own and others' abilities.

Gaps in the Literature

Although the research reviewed above provides valuable insight into how individuals perceive the relation between academic effort and ability and how ability evaluations are influenced by social comparison information, there are several notable gaps in the literature that future research should address. As discussed previously, much previous work conducted within the framework of both Nicholls (1978, 1984) and Dweck's (1999; Dweck & Master, 2009) theories focuses on how students' conceptions of *ability* influence how they relate quantity of effort to ability (e.g., Jagacinski & Nicholls, 1984; Hong et al., 1999) without directly measuring or manipulating students' perceptions about *effort*. More specifically, no previous studies except Muenks et al. (in press) examined how the *source* of effort might play a role. As discussed throughout this review, these perceptions might be important predictors of how students perceive the relation between quantity of effort and ability, and thus how they evaluate their own and others' academic abilities in school.

Koriat and colleagues (e.g., Koriat et al., 2006; Koriat & Nussinson, 2009; Koriat et al., 2009) examined data-driven and goal-driven functions of effort, but applied them to specific, task-based metacognitive outcomes (e.g., JOLs). These researchers examined the impact of situational task demands on the correlation between study time and individuals' judgments of learning for a particular task. However, they did not examine how individuals' perceptions of effort source might influence students' self-evaluations of ability. It is important to examine these more general self-beliefs, which predict a wide range of motivation- and achievement-related outcomes (e.g., Dweck, 2002; Wigfield et al., 2015; Bandura, 1997; Weiner, 1986; Eccles et al., 1983). Thus, it may be useful to manipulate students' beliefs or perceptions about effort source explicitly in order to examine whether these beliefs influence students' evaluations of their own abilities.

Heyman and colleagues (Heyman et al., 2003; Heyman & Compton, 2006) found that information about effort (i.e., feelings of ease/difficulty versus trying hard/not trying hard) might differentially influence children's ability evaluations of other people. However, they did not specifically examine individuals' perceptions of task-elicited and self-initiated effort. They also utilized a sample of young children who may not fully understand or be able to differentiate between the concepts of effort and ability, so there are developmental concerns with interpreting the results. Muenks et al. (in press) addressed these concerns by examining how task-elicited and self-initiated source of effort cues impacted college students' ability evaluations of others. However, they did not examine how these cues influenced participants' evaluations of *themselves*.

Given these gaps, it is important to extend extant literature in several ways, which I did in the proposed dissertation studies. First, participants' perceptions of task-elicited and self-initiated effort were manipulated directly: participants were told that they worked hard *because* of the subjective difficulty of the task or *because* they were self-motivated. Second, I examined how these perceptions of effort source influenced students' evaluations of ability, rather than their judgments of learning for a specific task. Third, because students' evaluations of themselves were much more proximal predictors of their motivation and achievement in school than their evaluations of others, I focused on students' self-evaluations of ability. Finally, I asked students to make self-evaluations as compared to other individuals, incorporating social comparison processes into the studies.

As discussed in Chapter 1, in order to address these gaps in the literature, the purpose of the present dissertation studies was to examine how perceived effort source (i.e., whether effort is perceived as being task-elicited or self-initiated) influenced students' ability evaluations of themselves as compared to another student. As will be discussed in more detail in Chapter 3, I examined this in two studies: one that utilized a vignette methodology (Study 1) and the other that placed participants in a more realistic scenario by having them complete an actual task (Study 2). Vignettes have been used extensively in the literature on students' perceptions of effort and ability (Kun et al., 1974; Kun, 1977; Droege & Stipek, 1993; Karabenick & Heller, 1976; Surber, 1980; Wimmer et al., 1982; Harari & Covington, 1981; Juvonen & Murdock, 1995), and are a useful methodological tool to examine students' cognitive processes in academic situations while controlling for potentially confounding variables. However, given that vignettes do have disadvantages, such as asking participants to imagine a hypothetical scenario that they may or may not experience in real life, in the second study participants completed a mathematics task and were asked to think about the effort they actually exerted.

In the present studies I utilized a sample of college students. College students are the chosen population for the present studies for several reasons. First, using a sample of older students (who are all over the age of 18) helped to control for any confounding effects of age or developmental level. As discussed previously, scholars disagree as to the exact age when individuals are able to differentiate between concepts of effort and ability (e.g., Karabenick & Heller, 1976; Surber, 1980), with at least one study indicating that even high school aged students might not yet fully understand the inverse relation between effort and ability (Harari & Covington, 1981). Thus, it is important to utilize a sample of adult students who researchers agree have formed a mature understanding of the concepts of effort and ability.

Second, many previous studies on effort source have utilized college student samples (e.g., Koriat et al., 2006; Koriat & Nussinson, 2009; Muenks et al., in press). Findings from the Koriat studies indicate that college students are sensitive to both data-driven and goal-driven regulation, and are able to attribute their effort to both sources. Muenks et al. (in press) found that college students appear to make different ability evaluations of other students depending on whether their effort is framed as task-elicited or self-initiated. Thus, effort source appears to be a useful and interesting construct to examine within this population. However, more research is needed to determine the processes by which effort source influences college students' perceptions of the relation between effort and ability.

Third, research suggests that college students use social comparison processes when forming evaluations of their abilities (e.g., Scheier & Carver, 1983; Wood, 1989; Wheeler, 1966; Wheeler, Koestner, & Driver, 1982), and that college students' self-evaluations of ability are particularly important predictors of their adjustment to college, grades, retention, and career prospects (e.g., Robbins, Lauver, Le, Davis, & Langley, 2004; Zajacova, Lynch, & Espenshade, 2005; Chemers, Hu, & Garcia, 2001; Lent, Brown, & Larkin, 1986). Thus, it is important to examine how effort source may influence self-evaluations within this population.

Both studies took place in the domain of mathematics. I chose to situate both studies within the same academic domain because previous researchers have found differences in how individuals conceptualize ability across different domains, such as math and reading (e.g., Grouws & Lembke, 1996; Buehl & Alexander, 2001). Thus, keeping both studies within the domain of math controlled for any confounding influences of domain on students' ability evaluations. Also, math is a domain for which most people believe an underlying ability exists (e.g., Burns & Isbell, 2007; Burkley, Parker, Stermer, & Burkley, 2010), whereas people may not hold that same belief about other college course domains, such as history and psychology. Since I asked students to evaluate their own domain-specific ability from their hypothetical effort in a specific college course (Study 1) or real effort on a task (Study 2), I figured math would be a good domain to utilize.

Conclusion

In this chapter, I reviewed previous theory and research on evaluations of ability and effort in various contexts, as well as how individuals conceptualize the relation between the quantity of academic effort and ability. I used social comparison theory and attribution theory as broad frameworks, and explored in depth two theories that make predictions about how students perceive the relation between effort and ability: one that is primarily developmental and situational in nature (Nicholls, 1978, 1984), and the other that focuses on individual differences (Dweck, 1999; Dweck & Master, 2009). Both of these theories and the accompanying empirical work focused on how conceptions of *ability* influence perceptions of the effort-ability relation but do not emphasize beliefs or perceptions about *effort*. Researchers from cognitive psychology (e.g., Koriat et al., 2006) introduced the concepts of data-driven and goal-driven effort but applied these concepts only to specific, metacognitive outcomes. Other recent work with young children (Heyman & Compton, 2006) examined how contextual effort cues influenced ability evaluations, but did not explicitly examine the role of task-elicited and self-initiated effort. Finally, Muenks et al. (in press) examined how source of effort cues influenced ability evaluations of others, but not ability evaluations of the self. The present studies therefore sought to apply the ideas of task-elicited and self-initiated effort to college students' own self-evaluations. Ultimately, this work could help researchers, educators, and parents better understand how students make assessments about their own and others' effort and ability, which has important consequences for students' motivation in school (e.g., Wigfield & Eccles, 2002; Bandura, 1997).

Chapter 3: Methods

Study 1

Design. The purpose of this study was to examine how information about effort source (i.e., whether it is described as task-elicited or self-initiated) influenced students' perceptions of the relation between levels of effort and ability, and, by extension, their evaluations of their own abilities as compared to those of other hypothetical students. Information about effort source was manipulated using vignettes, and participants evaluated their own abilities with a Likert-type scale. This study utilized a 2 x 2 x 2 experimental design with one between-subjects factor, source of effort condition (task-elicited, self-initiated), and two within-subjects factors, level of effort (high, low) and score (high, low). Each participant was randomly assigned to either the task-elicited or self-initiated condition, but received all combinations of level of effort and score conditions in randomized order.

Participants. As discussed in Chapters 1 and 2, undergraduate students were the target population. The sampling frame included undergraduate students enrolled at the University of Maryland, College Park. I used non-probability sampling, specifically convenience sampling, in order to recruit my participants. I recruited participants for Studies 1 and 2 simultaneously and used slightly different recruitment strategies for each study. Because I received a University of Maryland College of Education SPARC grant worth $1,000, I recruited participants for Study 1 through the University of Maryland Paid SONA system and paid them $4 for their participation.

The desired sample size for Study 1 was based on a power analysis conducted with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007, 2009). As described in more detail below, the main analysis I ran was a 2 (effort source: task-elicited, self-initiated) x 2 (effort level: high, low) x 2 (score: high, low) x 3 (evaluation order: first, second, third) ANOVA with one between-subjects factor and three within-subjects factors. I was specifically interested in a three-way interaction between effort source, effort level, and evaluation order. However, a previous study I conducted (Muenks et al., in press) with the same analysis yielded a very large effect size that would have resulted in an extremely small required sample size had I used it for this power analysis. I therefore decided to examine the required sample size I would need if I wanted to examine simple main effects between the effort source conditions (i.e., task-elicited, self-initiated) within each effort level condition (low, high), which is a more precise analysis. I conducted similar analyses in Studies 1a and 1b of Muenks et al. (in press) when I examined differences between effort source groups (task-elicited, self-initiated, and a control condition) within a particular score condition using *t*-tests. I decided to identify the smallest effect size from those *t*-tests and use that as the effect size in my current power analysis. I chose to do this because I wanted enough power to detect smaller simple main effects in addition to the overall main effects and interactions from the ANOVA.

Thus, the statistical test chosen within G*Power was "Means: Difference between two independent means (two groups)" which is part of the *t*-test family. This was a two-tailed *t*-test. The effect size d was calculated using an online *t*-test calculator (Becker, 2014). I calculated the effect sizes of all of the simple main effects between effort source groups within particular score conditions in Studies 1a and 1b of Muenks et al. (in press) by entering the *t* values and degrees of freedom into the online *t*-test calculator. The smallest effect size I found was in Study 1b and corresponded to a *t*-test examining the difference between the control group and the self-initiated group within the "no score" score condition. The effect size d for this analysis was 0.40, so this is what I entered into G*Power for the present power analysis. Power was set to 0.80 and alpha was set to .05 (Cohen, 1992). The Allocation ratio N2/N1 was left at 1, as I assume the number of participants in the effort source groups will be equal. After all the input parameters were entered, the total required sample size was 196 participants, which is approximately 98 participants per effort source group.

A total of 210 undergraduate participants completed the study. Due to an error in scheduling, one participant completed the study twice, so the data from the second time the participant completed the study was excluded from the analyses. The sample was 67.8% female, and the average age of participants was 20.29 years (SD = 1.82 years). The ethnic breakdown was 38.6% White, 26.2% Black, 22.9% Asian or Asian American, 7.1% Bi-racial or multi-racial, and 5.2% Hispanic. Students' majors were in the following categories: 24.3% Behavioral and Social Sciences, 21% Computer, Mathematical, and Natural Sciences, 11.4% Public Health, 11% Arts and Humanities, 10.5% Engineering, 9.5% Business, 4.3% Agriculture/Natural Resources, 2.9% Education, 1.9% Journalism, 1.4% Architecture, Planning, and Preservation, 1.4% Public Policy, and .5% stated they did not have a major.

Vignettes and dependent measures. Information about effort level, effort source, and score was manipulated using vignettes. For each vignette, participants were asked to imagine a past scenario in which they were sitting in a college-level mathematics class next to another student of the same gender, and the professor gave everyone in the class a set of problems to complete on their own in a certain amount of time. They then received effort level information. In the high effort conditions, they were asked to imagine that they spent the full amount of time on the task and worked hard, whereas the other student only spent a few minutes on the task and did not work hard. In the low effort conditions, they were asked to imagine the opposite: that they did not work hard, but the other student did. They were then asked to evaluate their math ability compared to the other student's using a 9-point Likert scale (1 = the other student's ability is much higher; 5 = they have the same ability; 9 = their ability is much higher). This was the first ability evaluation.

The next piece of information participants received depended on which source of effort condition they were in. Participants in the task-elicited group were told that the target person (themselves or the other student) who worked hard did so because they felt that the problems were very difficult, whereas the person who did not work hard did so because they felt that the problems were very easy. Those in the self-initiated group were told that the person who worked hard did so because he or she was motivated to engage in the task, whereas the person who did not work hard did so because he or she was not motivated to engage in the task. After receiving this information, participants were asked to make another ability evaluation comparing their math ability against the other student's, using the same item as before. This was the second ability evaluation.

Finally, participants were told score information: In the high score conditions, they were told that they received a higher score than the other student, whereas in the low score conditions, they were told that they received a lower score than the other student. They were asked to make an evaluation of their ability compared to the other student's using the same ability item as before. This was the third ability evaluation. See Appendix A for the full set of vignettes.

This sequential design allowed me to examine how participants' self-evaluations *changed* with each new piece of information—whether they increased, decreased, or stayed the same. I was therefore able to isolate the effects of each individual piece of information on participants' self-evaluations, which allowed me to specifically examine how effort source information influenced participants' ability evaluations given the amount of effort they exert, and how score information influenced participants' ability evaluations given the amount of effort they exert and the source of their effort. A similar design was used in Karabenick and Heller (1976) and Study 2 of Muenks et al. (in press). See Figure 2 for a visual depiction of the design for the Study 1 vignettes.

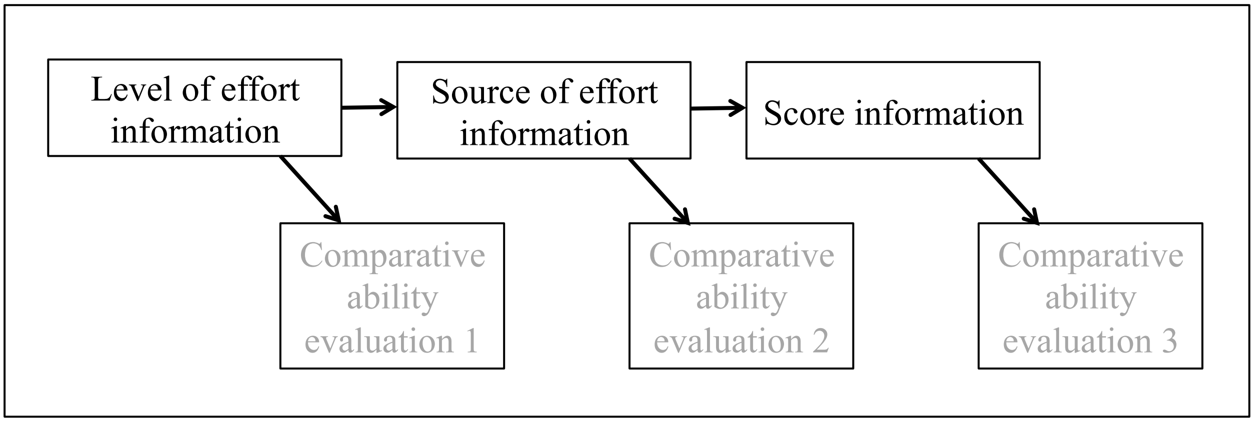

Figure 2. Design for the Study 1 vignettes. Boxes with black text correspond to the information participants received, while those with gray text correspond to the ability evaluations they were asked to make after receiving each piece of information.

Participants may evaluate their own ability differently based on the domain of the task and the gender of the comparison other (e.g., Bornholt, Goodnow, & Cooney, 1994). Thus, all vignettes took place in the domain of mathematics and participants were always asked to make comparisons of themselves with other students with gender-matched names in order to best control for these variables. In each vignette, participants were asked to imagine they were either in a college-level calculus or statistics class. I chose calculus and statistics because these are introductory-level math classes that most students (regardless of major) could realistically imagine taking.

Additional measures. In addition to the vignettes, participants completed four other measures: a measure of their beliefs about their math ability prior to the task, a measure of their social comparison orientation, a measure of the amount of social comparison information they perceive is available to them in their day-to-day lives, and a measure of their beliefs about intelligence. The last three measures were given at the very end of the study. I measured these variables so that I could examine any differences in these variables between the two effort source groups, and include them as covariates in the analyses.

Beliefs about math ability. Participants responded to the following question prior to reading the vignettes: How would you evaluate your own mathematics ability? They responded using a slider scale that ranges from 1-100; the anchors were “very low” to “very high”.

Social comparison orientation. Participants responded to four items about their social comparison orientation specifically for school. A sample item is, “I often compare myself to other students in my classes to determine how well I am doing academically.” Participants indicated their agreement or disagreement with each item on a 5-point Likert scale from 1 (I disagree strongly) to 5 (I agree strongly).[2] These items had good internal consistency with this sample ($\alpha = .89$).

Social comparison information available. Participants were asked to respond the item, “In general, how much information is available to you about how others are doing in your college classes?” (from 1 = very little to 5 = a lot).

Beliefs about intelligence. We used Dweck’s (1999) Theories of Intelligence (TOI) scale to measure participants’ general beliefs about the fixedness of intelligence. The version we used consists of eight items. Sample items are, “You have a certain amount of intelligence and you can’t really do much to change it” and “You can learn new things, but you can’t really change your basic intelligence.” Participants were asked to indicate the extent to which they agreed or disagreed with each item on a 6-point Likert scale from 1 (Strongly disagree) to 6 (Strongly agree). These items had excellent internal consistency with this sample ($\alpha = .95$).

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[2] For both studies, participants also completed a modified version of the Iowa-Netherlands Comparison Orientation Measure (Gibbons & Buunk, 1999), but analyses pertaining to those items are not reported here.

Procedure. Participants entered the laboratory and were asked to sit in front of a computer. The experimenter (i.e., either me or an undergraduate research assistant) went over the consent form with the participant and asked if he or she had any questions before beginning the study. The experimenter then clicked on a bookmark that was saved within the browser of one of two versions of the study: Version 1 was for males, and Version 2 was for females. I did not ask participants to report their own gender before participating in the study due to concerns about stereotype threat, which can impact especially females' performance on math tasks and beliefs about their ability in math (e.g., Steele & Aronson, 1995). The experimenter then entered an ID number into the computer for each participant, and informed the participant that the study should take approximately 20 minutes. Once the study began, participants saw the following on the screen:

> Welcome!
>
> Before we begin, please answer the following question.
>
> How would you evaluate your own mathematics ability?

After they make an evaluation of their mathematics ability using the slider scale (described above), they were shown the following instructions:

> Please read the following hypothetical scenarios.
>
> Although the scenarios will seem similar to one another, there are some key differences, so it is important that you read each one carefully.
>
> In each scenario, you will be asked to imagine that you are in a college level class next to another student. You will be given some information and then asked to evaluate your own ability as compared to the other student. You will then be given additional pieces of information and asked to evaluate your own ability as compared to the other student after

each piece of information is presented. You will make a total of three evaluations per scenario. Please make your evaluations based on what you think is **most likely** given the information.

Finally, at the end of the study, you will be asked to indicate your agreement or disagreement with a few additional statements about yourself.

There are no right or wrong answers; we are interested in your opinions.

Participants then completed a total of eight vignettes using the web-based survey tool Qualtrics: two vignettes for each combination of the within-subjects factors (i.e., high effort-low score, high effort-high score, low effort-low score, and low effort-high score). So for example, there were two high effort-low score vignettes, two high effort-high score vignettes, and so on; this helped to increase reliability. Small details, such as the type of mathematics classroom (i.e., calculus or statistics), exact timing information, and name of the other student were changed between these two vignettes in order to reduce repetition. The order of presentation of all eight vignettes was randomized for each participant (e.g., participants did not necessarily get the two vignettes that were similar directly after one another). In order to give participants a break from reading so many similar vignettes, participants were given a two-minute break after the first four vignettes they read. During this break, they were asked to list as many United States state capitals as they can in two minutes by typing them into a text box. After two minutes had passed, they were able to continue reading and responding to the vignettes.

After responding to all eight vignettes, participants completed the social comparison orientation scale and the amount of social comparison available item. They also completed the Theories of Intelligence scale. Participants then responded to questions asking about their major, age, gender, and ethnicity. Participants were fully debriefed at the end of the study via information on the computer screen. See Appendix A for the full set of demographic questions and the debriefing information.

Data analysis plan. In order to test Hypotheses 1 and 2 (see Chapter 1), I ran a 2 (effort source: task-elicited, self-initiated) x 2 (effort level: high, low) x 2 (score: high, low) x 3 (ability evaluation order: first, second, third) ANCOVA, with repeated measures on the last three factors. Students' self-evaluations of ability were the dependent variables. Students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence were entered as covariates in each analysis. I was able to examine whether participants' ability evaluations increased or decreased after they received information about effort source (i.e., between the first and second ability evaluation) in both the low and high effort conditions. I was also able determine whether participants endorsed an overall positive or negative relation between effort and ability by examining whether they evaluated their own ability (as compared to the other hypothetical student) higher when they exerted low effort (which is consistent with an inverse relation) or when they exerted high effort (which is consistent with a positive relation).

I looked at all main effects and interactions, but was particularly interested in specific interactions and planned comparisons that directly tested my hypotheses (see below). All significant main effects and interactions were followed up with various post hoc tests to determine whether the means significantly differed from each other. Because I ran so many statistical tests, the experiment-wise error rate may have been high, which means that there was an increased chance of making a Type I error (e.g., getting at least one *p*-value that was less than .05, even if it does not reflect an actual difference between means). There are several different ways of dealing with the experiment-wise error rate. One of the most common ways to deal with this problem is to use the Bonferroni correction (e.g., Bland & Altman, 1995), in which researchers use a modified alpha value (α/k, where k is the number of statistical tests conducted). However, critics of Bonferroni correction argue that it is too conservative, reduces power, and results in a very high Type II error rate (e.g., Nakagawa, 2004). Nakagawa (2004) recommends that, in order to mitigate this concern, researchers should not place all emphasis on statistical significance (i.e., p values), but should also report effect sizes. Standardized effect sizes are measures of the strength of experimental effects. They are comparable across studies even with different sample sizes, which allows researchers to determine the practical importance of the results. Thus, in the present studies, I reported not only the p-values for all of my analyses but also the partial eta squared, which is an indicator of effect size (e.g., Nakagawa, 2004). Additionally, because the effects I examined all have *a priori* theoretical justification, I did not haphazardly search for significant effects in the data but focused on specific hypothesized interactions.

In order to test my hypotheses, I was specifically interested in two analyses. First, I examined the effort source x effort level x ability evaluation order three-way interaction because I wanted to see how participants' ability evaluations changed after they received effort source information (i.e., between the first and second evaluations) based on effort level and effort source information. As stated in the hypotheses for this study, I expected to find that participants in the task-elicited, low effort condition would increase their ability evaluations from the first to the second evaluation, whereas participants in the task-elicited, high effort condition would decrease their ability evaluations from the first to the second evaluation. In contrast, I expected that participants in the self-initiated, low effort condition would decrease their ability evaluations from the first to the second evaluation, whereas participants in the self-initiated, high effort condition would increase their ability evaluations from the first to the second evaluation. Second, in order to test whether participants in each effort source condition endorsed an overall positive or inverse relation between effort and ability, I calculated the difference between the estimated mean of participants' ability evaluations after receiving effort source information (i.e., the second ability evaluation) in the high effort condition versus the low effort condition. Difference scores were not calculated for each individual participant; thus, there is only a single difference score for each effort source condition (task-elicited and self-initiated). I expected that the difference score for the task-elicited condition would be significantly negative, which suggests and inverse relation between effort and ability, whereas the difference score for the self-initiated condition would be significantly positive, which suggests a positive relation between effort and ability. This pattern of effects would support Hypotheses 1 and 2.

Although not part of my focal hypotheses, I also expected to find some additional main effects and interactions. Based on results from Muenks et al. (in press) Study 2, which used a similar design, I expected to find a main effect of score: participants would evaluate their own abilities higher overall when they receive a high score as opposed to a low score. I also expected to find a score x ability evaluation order interaction: if participants received a high score their evaluations would increase from the second to the third evaluation (i.e., after receiving score information), whereas if they received a low score their evaluations would decrease from the second to the third evaluation. These results would be consistent with prior research (e.g., Kun, 1977; Heyman et al., 2003). Finally, I explored significant covariate main effects and interactions, in order to determine whether the covariates moderated any of my effects; I did not have any specific hypotheses regarding these main effects or interactions.

Study 2

Design. The purpose of Study 2 was to extend Study 1 by examining how effort source information influenced ability evaluations in a more realistic situation. Rather than using vignettes, participants were asked to complete a math task, and were told that another (hypothetical) student of the same gender completed the same task (see detailed description and rationale for the task below). They were asked to report how much effort they exerted on the task and were told that the other student either exerted more or less effort than they did. Their effort (along with the other student's) was framed as either task-elicited or self-initiated (or neither in the control condition), and they were asked to make an evaluation of their own math ability compared to the other student's. This study utilized a 3 x 2 experimental design with two between-subjects factors, source of effort (task-elicited, self-initiated, control) and level of effort (high, low). Each participant was assigned to one of six conditions: task-elicited-low effort, task-elicited-high effort, control-low effort, control-high effort, self-initiated-low effort, or self-initiated-high effort.

Participants. The population and sampling frame for Study 2 was the same as in Study 1, explained above. However, the sampling plan was different. Rather than paying participants cash for their participation, I utilized the University of Maryland SONA system for undergraduate recruitment, which is a system that allows undergraduates to receive course credit for participating in research studies. All participants received 0.5 course credits for this 30-minute study.

The desired sample size was based on a power analysis conducted with G*Power 3.1 (Faul et al., 2007, 2009). The statistical test chosen for the a priori power analysis was "ANCOVA: Fixed effects, main effects and interactions", since the focal analysis of the current study was examining differences in ability evaluations between the six groups. Power was set to 0.80 and α was set to .05 (Cohen, 1992). The number of groups was 6 (task-elicited-high effort, task-elicited-low effort, self-initiated-high effort, self-initiated-low effort, control-high effort, control-low effort) and the numerator df was set to 2, which was calculated with the formula numerator df = (# levels in first factor – 1)(# levels in second factor – 1) (G*Power, 2014). The number of covariates was set to 3 (effort distance, initial self-evaluation of math ability, and social comparison orientation—all explained below[3]). The effect size f was set to 0.25, which is considered a medium effect. A previous study I conducted with a similar analysis yielded a very large effect size (Muenks et al., in press) but I wanted to be conservative and have enough power to detect a medium effect. Thus, the total sample size needed was 158 participants, or approximately 26 participants per group.

A total of 172 undergraduate students participated in the study. Three participants were excluded from the analyses due to not completing the study: One participant voluntarily quit the study after only a few minutes, and two other participants were not able to complete the study due to technological issues. An additional nine participants were excluded from the analyses because they had a value of '0' on the "Effort Distance" variable (explained in more detail below). Thus, the final sample consisted of 160 undergraduate participants. The sample was 78.1% female, and the average age of participants was 19.49 years (SD = 1.45 years). The ethnic breakdown was 52.5% White, 25% Asian or Asian American, 10.6% Black, 7.5% Bi-racial or multi-racial, and 4.4% Hispanic. Students' majors were in the following categories: 36.3% Behavioral and Social Sciences, 26.3% Computer, Mathematical, and Natural Sciences, 14.4% Public Health, 4.4% Other, 3.8% Agriculture/Natural Resources, 3.1% Arts and Humanities,

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[3] I added two additional covariates to the final analyses: amount of social comparison information available and theories of intelligence.

2.5% Business, 2.5% Journalism, 1.9% Engineering, 1.3% Education, and 3.8% indicated they did not have a major.

Measures.

Dependent measures. After completing the task and going through the effort source and effort level manipulations (explained in more detail below), participants evaluated their own math abilities at three levels of specificity: Their ability on the specific fraction task, their general fraction ability, and their general math ability. In each case, they were told, “Now, please evaluate your own [ability on this specific fraction task, general fraction ability, general math ability] compared to the other participant’s” on a 9-point Likert scale from 1 = [His/her] ability is much higher, 5 = Our abilities are the same, 9 = My ability is much higher.

Beliefs about math ability. Participants responded to the same question as in Study 1 measuring their belief about their math ability.

Social comparison orientation. Participants completed the same social comparison orientation items described in Study 1. These items had good internal consistency with this sample ($\alpha = .85$).

Social comparison information available. Participants were asked to respond the item, “In general, how much information is available to you about how others are doing in your college classes?” (from 1 = very little to 5 = a lot).

Beliefs about intelligence. Participants completed Dweck’s (1999) eight-item Theories of Intelligence (TOI) scale described in Study 1. These items had excellent internal consistency with this sample ($\alpha = .95$).

Materials and procedure. Participants entered the laboratory and were placed in front of a computer. The experimenter (i.e., either me or an undergraduate research assistant) went over the consent form with the participant and asked if he or she had any questions before beginning the study. The experimenter then clicked on a bookmark that was saved within the browser of one of two versions of the study: Version 1 was for males, and Version 2 was for females. As in Study 1, participants were not asked to report their own gender in order to reduce concerns about stereotype threat. The experimenter then entered an ID number into the computer for each participant, and informed the participant that the study should take approximately 30 minutes to complete. Once the study began, participants saw the following on the screen:

> Welcome!
>
> Before we begin, please answer the following question.
>
> How would you evaluate your own mathematics ability?

After the participants evaluated their own math ability using the same item and scale as in Study 1 (see above), they received the following instructions:

> You will now be asked to complete a math task having to do with modifying recipes. This is the same math task that another [male/female] undergraduate participant completed a few days ago.
>
> For this task, you will be provided with four different recipes. Each recipe will include a list of ingredients with specific quantities. You will then be asked to change those quantities, for example by doubling or halving the recipes, without using a calculator. Please reduce the fraction to its simplest form. For all fractions greater than 1, you will need to provide your answers as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25).

Participants were told that another undergraduate participant of the same gender completed the task a few days ago because they were later asked to compare their ability to that of the other participant. Participants' perceptions of effort source were experimentally induced both before and after the task. Before the task, participants in the task-elicited conditions were shown the following sentence on their screen: "A lot of people work hard on this task because it is difficult." Participants in the self-initiated conditions were shown: "A lot of people work hard on this task because they feel motivated to complete it." Participants in the control conditions were shown: "A lot of people work hard on this task." The purpose of including this information at the beginning of the study was so that participants can begin to think about effort source while they were actually working on the task. Finally, all participants were told: "Please complete this task in one sitting, without stopping. You may use a pen and paper, but please do NOT use a calculator. Click 'Continue' to begin."

Participants then completed the task, using as much time as needed. The task itself consisted of four different baking or cooking recipes, each with a list of approximately 10-13 ingredients with specific quantities (see Appendix B for the full set of recipes). A photo of the food accompanied each recipe so that the task seems more realistic. Participants were asked to change the quantities of the ingredients based on various ratios, for example by doubling or halving the recipe, without using a calculator. For example, they were told something like, "This recipe calls for 12 servings, and you would like to make 4 servings." Then, they saw a list of ingredients, such as "2 1/3 cup butter" and were asked to provide the new ingredient quantity in the same unit as a mixed number.

I chose to have participants complete a fraction recipe task because it seemed challenging yet still possible for a general college student population to complete successfully. Most college students have developed skills related to multiplying and dividing fractions, but these tasks can be made more difficult by including more unusual fractions. I wanted the task to be difficult enough that I could realistically induce perceptions of task-elicited effort for participants in the task-elicited condition, but I also wanted the task to be motivating enough that I could realistically induce perceptions of self-initiated effort for participants in the self-initiated condition. I thought that a fraction task related to cooking and baking recipes could be useful in real life, and thus participants could be motivated to complete the task. I did not want to ask participants to engage in a complex calculus or algebra task because I wanted the task to be accessible to students at all levels of math, and also because I did not necessarily think a calculus or algebra task would be very motivating. I pilot tested this recipe task in May 2014 with several graduate students, professors, and other adults ($N = 13$), who gave useful suggestions to improve the task. Participants in this pilot study were also asked several questions regarding their feelings about the task on a 1-100 scale. They indicated that they took the recipe task seriously ($M = 82.31$, $SD = 14.23$) and felt motivated to engage in the recipe task ($M = 73.54$, $SD = 14.19$), and several participants gave verbal feedback indicating that they felt the task was challenging. I therefore felt confident that I could experimentally induce perceptions of either task-elicited or self-initiated effort on the task.

After participants completed the calculations for all four recipes, they reported the level of their effort. On the computer screen, they were asked, "On a scale from 1 to 10, how much effort did you feel that you exerted on this task?" (from 1 = very little effort at all to 10 = a great deal of effort). Next, participants in the task-elicited and self-initiated conditions were asked to respond to a total of five open-ended questions about their effort on the task. These questions were intended to induce participants' perceptions of their own effort as either task-elicited or self-initiated. Participants in the control conditions did not respond to any open-ended questions.

Participants in the task-elicited conditions answered questions such as, “What specific aspects of this task were most difficult?” and “What specific aspects of this task were easiest?” They were required to provide a response that was at least 50 characters long for each question so that they had to write down at least one sentence. All of the questions in the task-elicited condition were focused on the perceived properties of the task itself, not the individual, and thus were intended to put participants in the mindset of task-elicited effort. The rationale behind this manipulation strategy is that, by coming up with and writing responses to these questions, participants would perceive their own effort (however much they exerted) as arising primarily from the perceived demands of the task.

Participants in the self-initiated conditions answered questions focused on the individual’s own motivation, such as, “What, specifically, increased your motivation during the task?” and “What, specifically, decreased your motivation during the task?” They were also required to provide a response that was at least 50 characters long for each question. These questions emphasized the motivation (or lack of motivation) from the self rather than the perceived demands of the task. Coming up with responses to these open-ended questions was intended to encourage participants to perceive their own effort on the task as being self-initiated.

Originally I did not intend to code the responses to these questions nor using them in any analyses because the responses themselves were not of interest to the hypotheses of the study. Simply having the participants write out their responses to these questions comprised the manipulation. However, as will be discussed in Chapter 5, I did end up coding some of the responses in order to make sense of the findings. See Appendix B for all questions.

Next, in order to incorporate the social comparison aspect of the design, participants were told:

> Now, I want you to compare your ability to the other [male/female] undergraduate participant who completed the task a few days ago. But first, I want to give you some information about the participant's effort. The other participant finished the task approximately 5 minutes [slower/faster] than you. You indicated the level of your effort as a ___, and the other participant indicated [his/her] level of effort as a ___.

In the high effort conditions, participants were told that the other participant finished the task five minutes *faster* than they did and reported that he or she exerted *less* effort than they did. In the low effort conditions, participants were told that the other participant finished the task five minutes *slower* than they did and reported that he or she exerted *more* effort than they did. Participants were told both of these pieces of information (i.e., that the other participant spent more or less time than them on the task *and* that they self-reported exerting more or less effort), because it seemed more convincing to include both pieces of information than simply one or the other. Some participants may not have taken others' self-reports of effort seriously, so it may be useful to have a more "objective" measure of effort (i.e., time). At the same time, some participants may not necessarily have associated time with effort (i.e., they may believe it is possible for someone to spend a lot of time on a task but still not work very hard), so having a self-report measure of effort in addition to the time might have been more convincing. Participants were always told that the other participant finished five minutes faster or slower than them. Pilot testing on the task indicated that participants spent, on average, twenty minutes on the task. Five minutes therefore seemed like a reasonable amount of time to vary between the conditions because it is a large enough difference to convince participants that the amount of time they spent on the task was clearly differentiated from the other participant's, but not so large that it was unrealistic.

In terms of the self-report information, in most cases, participants were told that the other participant either rated their own effort as three points higher than them or three points lower than them. For example, in the high effort conditions, participants who rated their own effort as a five on the 10-point scale were told that the other participant rated their effort as a two. In the low effort conditions, participants who rated their own effort as a five were told that the other participant rated their own effort as an eight (see Appendix B for more detailed information about this manipulation). Three seemed like a reasonable distance as it spanned about one third of the total scale. Post hoc analyses revealed that a difference of three on the 1-10 scale was equivalent to a difference of about 3.7 standard deviations; thus, to participants, this should seem like a large and meaningful difference in effort level.

In some cases, however, I was not able to create a distance of three between the reported levels of effort. In the high effort conditions if the participant rated their effort as either a three, two, or one, or in the low effort conditions if the participant rated their effort as either an eight, nine, or ten, they were told that the other participant rated their effort as the extreme of the scale (either a one or a ten), and thus the "distance" between the two individuals' effort was less than three. In the extreme case that a participant rated their effort as a one in one of the high effort conditions or a ten in one of the low effort conditions, they were told that the other participant exerted the same amount of effort as they did. These participants ($N = 9$) were removed from the analyses, as described above. Additionally, in order to control for the distance between the two participants' level of effort, I created a variable called "effort distance" (which was simply the distance between the participant's own rating of effort and the hypothetical participant's rating) to use a covariate in my analyses.

At the end of the study, participants were asked to evaluate their own ability compared to the other participant's. They made three ability evaluations in a fixed order: 1) their ability on this specific fraction task, 2) their general fraction ability, and 3) their general math ability. These evaluations were treated as three separate dependent variables in the analyses. I expected that I would see the biggest differences between conditions in participants' more specific ability evaluations (as it is unlikely that there will be major changes in their overall math ability self-concepts based on this 30-minute task) and so the two more specific evaluations are of most interest. Thus, I chose to have participants make the specific evaluations first and then the more general one. After evaluating their ability, participants completed the social comparison orientation scale, the item about social comparison information available, and the Theories of Intelligence scale. Participants concluded the study by providing demographic and general academic information and were thoroughly debriefed via information on the computer screen (see Appendix B for demographic questions and debriefing information). See Figure 3 for a visual depiction of the experimental design of Study 2 (note that this does not include the additional measures).

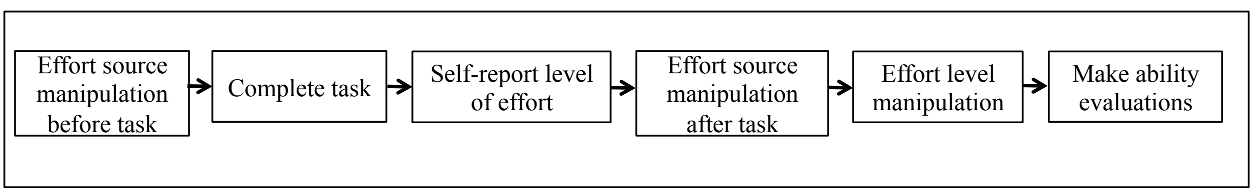

Figure 3. Experimental design for Study 2.

Data analysis plan. Hypothesis 1, which is that when students perceive their own effort as task-elicited they will evaluate their ability higher when they exert less effort (and vice versa), and Hypothesis 2, which is that when students perceive their own effort as self-initiated they will evaluate their ability higher when they exert high effort (and lower when they exert low effort; see Chapter 1), was addressed with three 3 (effort source: task-elicited, self-initiated, control) x 2 (effort level: high, low) ANCOVAs. I ran a separate ANCOVA for each of the three dependent variables (i.e., self-evaluations for ability on specific fraction task, general fraction ability, and general math ability). Effort distance, students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence were entered as covariates in each analysis.

Unlike in Study 1, I was not able to examine whether participants individually endorsed a positive or inverse relation between effort and ability, because they were simply asked to evaluate their ability as compared to the other participant. I then compared *across* groups (i.e., I looked at whether participants in the task-elicited low effort group rated their abilities higher than participants in the task-elicited high effort group) to get a sense for the overall relation between effort and ability. If participants in the low effort groups evaluated their own task-specific/fraction/math ability (as compared to the "other" hypothetical participant) higher than participants in the high effort groups, that is consistent with an inverse relation between effort and ability. If participants in the high effort groups evaluated their own ability (as compared to the "other" participant) higher than participants in the low effort groups, that is consistent with a positive relation.

I looked at the main effects and interaction for each ANCOVA (i.e., effort source, effort level, effort source x effort level). Significant main effects and interactions were followed up with post hoc tests to determine whether the means significantly differed from each other. As in Study 1, I reported not only the *p*-values for all of my analyses but also the partial eta squared, which is an indicator of effect size (e.g., Nakagawa, 2004).

Although I had three separate dependent variables (i.e., self-evaluations for ability on the specific fraction task, general fraction ability, and general math ability) and ran three separate analyses, I expected to find similar results for all three ANCOVAs. As discussed briefly above, I expected the results would be strongest for the more specific evaluations (i.e., ability on the specific fraction task, general fraction ability) and less strong for the more general evaluation (i.e., math ability). However, I did expect to find an interaction between effort source and level of effort in all three analyses. Specifically, I expected that participants in the task-elicited high effort condition would evaluate their own ability (as compared to the other student in the vignette) *lower* than participants in the task-elicited low effort condition (which is consistent with an *inverse* relation between level of effort and ability). In contrast, I expected that participants in the self-initiated high effort condition would evaluate their own ability (as compared to the other student) *higher* than participants in the self-initiated low effort condition (which is consistent with a *positive* relation between level of effort and ability). I expected that participants in the control high effort condition would evaluate their own ability (as compared to the other participant) lower than participants in the control low effort condition (consistent with conceiving of an *inverse* relation between level of effort and ability), but I expected that the mean evaluations would fall in between those of the other two groups (similar to the pattern found in Muenks et al., in press). These interactions would support Hypotheses 1 and 2.

Finally, as a supplemental analysis, I explored covariate main effects, in order to determine whether any of the covariates were significantly related to participants' ability evaluations.

Summary

The current studies are among the first to examine whether undergraduate students' perceptions of the source of effort influence the direction of the relation between level of effort and ability. As discussed in Chapters 1 and 2, this issue is important to address because how students think about the relation between level of effort and ability has important implications for their ability evaluations of themselves and others, which have critical motivational consequences. Additionally, they build on Muenks et al. (in press) by examining participants' own ability evaluations as an outcome, rather than their evaluations of others. These studies more directly connect participants' evaluations of others to their evaluations of themselves, and thus provide additional information about the importance of perceptions of effort source in the formation of these self-beliefs.

Study 1 consisted of a series of vignettes that participants responded to on the computer. They were asked to imagine themselves in academic situations where they were completing a task at the same time as another student. They were given information about how much effort they (and the other student) put forth on the task, the source of their (and the other student's) effort, and the scores that both they and the other student received on the task. They made evaluations of their own ability compared to the other student after receiving each piece of information.

Study 2 extended Study 1 by having participants actually complete an academic task that they were told another participant had previously completed. They were given information about how much effort they put forth compared to the other student, and their perceptions of the source of their own effort were manipulated. They were then asked to make evaluations of their own ability compared to the other student. This study provided an important extension to Study 1 by examining whether source of effort information influenced students' self-evaluations in more realistic academic contexts.

Chapter 4: Results

Study 1

Overview of the main analyses. As discussed in Chapter 3, in order to test Hypotheses 1 and 2, I ran a 2 (effort source: task-elicited, self-initiated) x 2 (effort level: high, low) x 2 (score: high, low) x 3 (ability evaluation order: first, second, third) ANCOVA, with repeated measures on the last three factors. I included four covariates into this analysis: students' initial beliefs about math ability (e.g., the item "How would you evaluate your own mathematics ability?" that participants responded to before beginning the study), students' social comparison orientation (measured with four items at the end of the study; see Chapter 3), reported amount of social comparison information available (e.g., the item "In general, how much information is available to you about how others are doing in your college classes?" that participants responded to at the end of the study), and theories of intelligence. I also reported any significant main effects or interactions of these covariates with the experimental conditions.

In order to test whether individuals endorsed an overall positive or inverse relation between effort and ability, I also calculated the difference score between participants' ability evaluations after receiving effort source information (i.e., the second ability evaluation) in the high effort condition versus the low effort condition for participants in both the task-elicited and self-initiated groups.

Before conducting the main ANCOVA, I examined mean differences on the four covariates for participants in the different effort source groups, and also examined whether there were any effects of domain (i.e., calculus versus statistics) for the vignettes. I describe these analyses below. I then discuss the results of the ANCOVA and the calculation of difference scores.

Mean differences on covariates for between-subjects groups. The four covariates, as discussed above, were students' initial beliefs about their mathematics ability, their social comparison orientation, the amount of social comparison information available to them in general, and their theories of intelligence. Table 1 contains the means and standard deviations for all the covariates in Studies 1 and 2. Before conducting the main ANCOVA, I examined whether participants in the task-elicited (N = 105) and self-initiated (N = 105) groups differed on the levels of these variables by conducting a series of independent samples *t*-tests. There were no differences for initial ability evaluation, $t(208) = -.11$, $p = .91$, social comparison orientation, $t(208) = .61$, $p = .54$, or theories of intelligence, $t(208) = -.096$, $p = .92$, but there was a statistically significant difference for the amount of social comparison information available, $t(208) = 2.25$, $p = .03$. Participants in the task-elicited group reported that significantly more social comparison information was available to them ($M = 3.29$, $SE = .10$) than participants in the self-initiated group ($M = 2.96$, $SE = .11$).

Table 1

Means and standard deviations of all covariates for Studies 1 and 2

	Study 1		Study 2	
	M	SD	M	SD
Ratings of mathematics ability	71.42	17.94	68.32	18.39
Social comparison orientation	3.72	0.96	3.75	0.85
Social comparison information available	3.12	1.06	2.99	1.11
Theories of intelligence	2.82	0.99	2.72	1.07
Effort distance (Study 2 only)			2.60	0.81

Domain effects. As discussed in Chapter 3, participants completed two vignettes per condition in order to increase reliability. So for example, participants in the task-elicited condition responded to two high effort-low score vignettes, two high effort-high score vignettes, and so on. Small details, such as the type of mathematics classroom (i.e., calculus or statistics), exact timing information, and name of the other student were changed between the two vignettes in order to reduce repetition. Before averaging the two vignettes together, I wanted to examine whether these small changes between the two vignettes, including type of mathematics classroom (i.e., domain), influenced the results. To do this, I ran a 2 (effort source: task-elicited, self-initiated) x 2 (effort level: high, low) x 2 (score: high, low) x 2 (domain: calculus, statistics) x 3 (ability evaluation order: first, second, third) ANCOVA, with repeated measures on the last four factors (and all four covariates), in order to examine whether there were any main effects or interactions with domain.

Results indicated a significant four-way interaction between effort level x ability evaluation order x domain x effort source condition, $F(2, 408) = 23.95$, $p < .001$, $\eta^2_p = .11$, with a medium effect size. However, this interaction is not interpretable and thus I will not discuss it here. I decided to simplify the main analysis by removing domain as a within-subjects factor. Instead, I averaged the two vignettes within the same effort level-score condition. Thus, the final analysis was, as discussed above, a 2 (effort source: task-elicited, self-initiated) x 2 (effort level: high, low) x 2 (score: high, low) x 3 (ability evaluation order: first, second, third) ANCOVA, with repeated measures on the last three factors, and four covariates.

Results from main ANCOVA. There were main effects of score, $F(1, 204) = 17.80$, $p < .001$, $\eta^2_p = .08$, and order, $F(2, 408) = 6.71$, $p = .001$, $\eta^2_p = .03$, that were qualified by a score x order interaction, $F(2, 408) = 30.26$, $p < .001$, $\eta^2_p = .13$. As expected (see Chapter 3), when participants were told that they scored higher than the other participant before the third ability evaluation, they tended to evaluate their math ability higher on the third evaluation ($M = 7.59$, SE

= .06) than the second evaluation (*M* = 5.14, *SE* = .04). And, when participants were told that they scored lower than the other participant before the third ability evaluation, they judged their math ability lower on the third evaluation (*M* = 2.80, *SE* = .07) than the second evaluation (*M* = 5.19, *SE* = .05). This interaction had a medium effect size.

There was also a significant effort level x effort source interaction, $F(1, 204) = 93.73$, $p < .001$, $\eta^2_p = .32$, with a large effect size, where participants in the task-elicited condition rated their ability higher in the low effort (*M* = 6.37, *SE* = .09) versus the high effort (*M* = 4.00, *SE* = .10) condition, $t(208) = 17.62$, $p < .001$, while participants in the self-initiated condition did not differ in their ability judgments between the low effort (*M* = 5.28, *SE* = .09) and the high effort (*M* = 5.06, *SE* = .10) condition, $t(208) = 1.64$, $p = .10$. In order to qualify this further, as expected, there was a significant effort source x effort level x ability evaluation order three-way interaction, $F(2, 408) = 141.88$, $p < .001$, $\eta^2_p = .41$, with a large effect size. As expected, participants in the task-elicited, low effort condition increased their ability evaluations from the first (*M* = 6.30, *SE* = .13) to the second (*M* = 7.04, *SE* = .12) evaluation (once they received effort source information), while participants in the task-elicited, high effort condition decreased their ability evaluations from the first (*M* = 4.06, *SE* = .14) to the second (*M* = 3.29, *SE* = .13) evaluation. In contrast, participants in the self-initiated, low effort condition decreased their ability evaluations from the first (*M* = 5.64, *SE* = .13) to the second (*M* = 4.61, *SE* = .12) evaluation, whereas participants in the self-initiated, high effort condition increased their ability evaluations from the first (*M* = 4.64, *SE* = .14) to the second (*M* = 5.74, *SE* = .13) evaluation. See Table 2 in Appendix C for means and standard errors for this interaction, Figure 4 for a depiction of the full interaction, and Figure 5 for results from Evaluation 2.

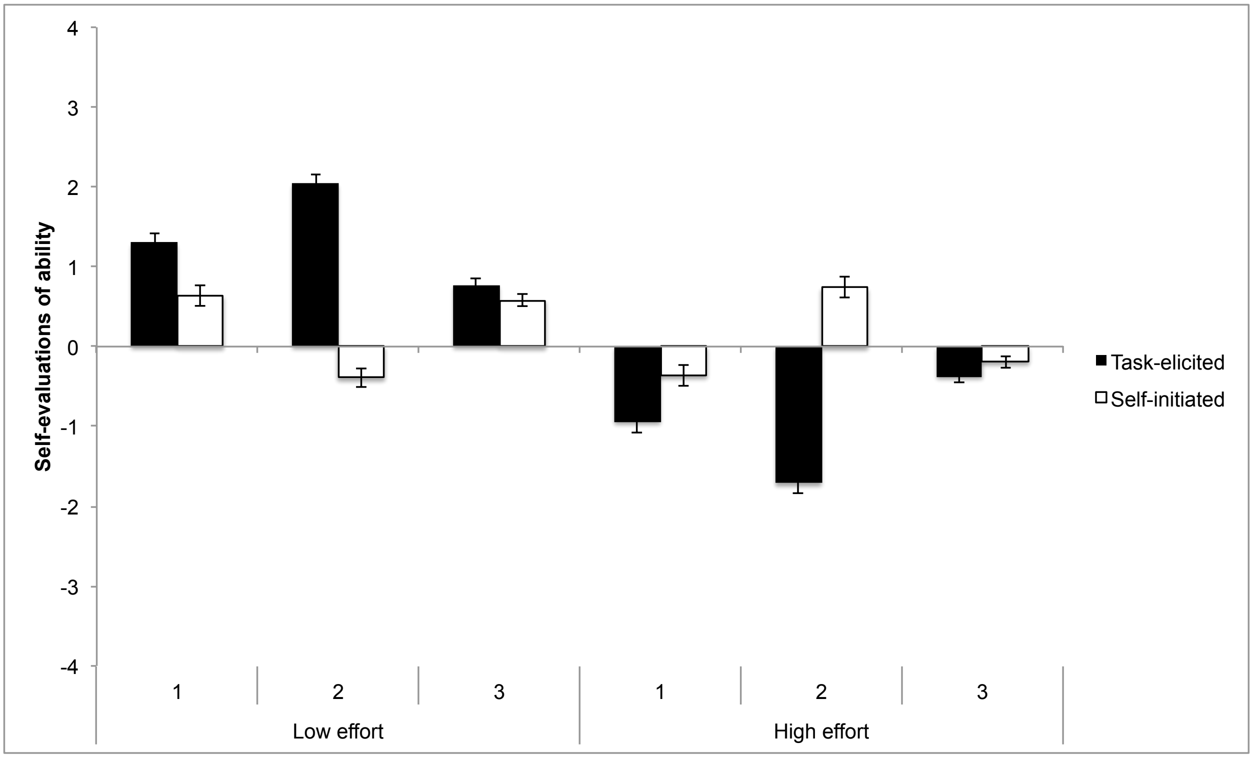

Figure 4. Effort source x effort level x ability evaluation order three-way interaction for Study 1. The y-axis represents students' self-evaluations of ability as compared to the other hypothetical student, and is centered at the midpoint. Values greater than zero indicate that the participant rated their ability higher than the "other" participant, and values less than zero indicate that the participant rated their ability lower than the "other" participant. The numbers on the x-axis indicate the ability evaluation order (i.e., first, second, or third evaluation). Before the first evaluation participants received effort level information (low effort or high effort), before the second evaluation participants received effort source information (task-elicited or self-initiated), and before the third evaluation participants received score information (low or high score).

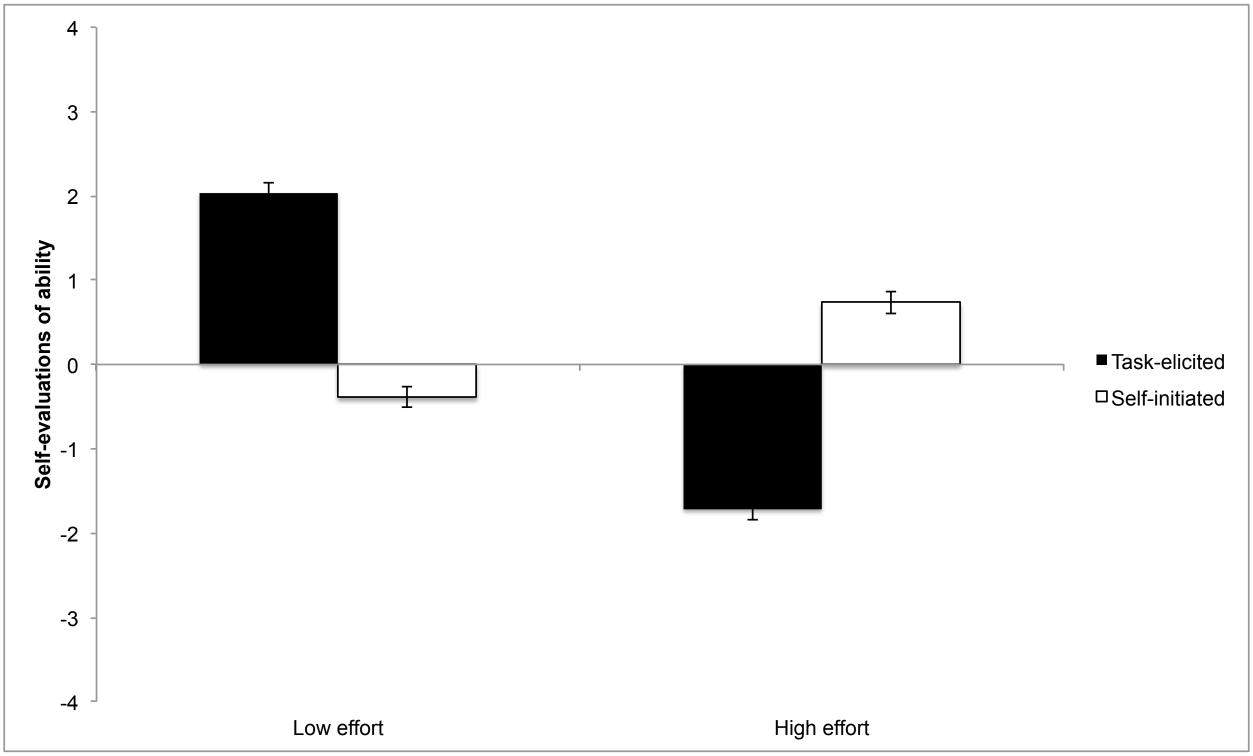

Figure 5. Students' self-evaluations of ability as compared to the other hypothetical student after receiving effort source information (i.e., the second evaluation) for Study 1. The y-axis represents students' self-evaluations of ability as compared to the other hypothetical student, and is centered at the midpoint. Values greater than zero indicate that the participant rated their ability higher than the "other" participant, and values less than zero indicate that the participant rated their ability lower than the "other" participant.

Covariate main effects and interactions. There were main effects of students' initial ability evaluation, $F(1, 204) = 16.97$, $p < .001$, $\eta^2_p = .08$, and total social comparison information available, $F(1, 204) = 16.40$, $p < .001$, $\eta^2_p = .07$, and these effect sizes were small. Students who had higher initial evaluations of their math ability and higher social comparison orientation had higher self-evaluations of ability on average. There were significant score x social comparison orientation, $F(1, 204) = 10.47$, $p = .001$, $\eta^2_p = .05$, and score x TOI, $F(1, 204) = 4.38$, $p = .04$, $\eta^2_p = .02$, interactions, with small effect sizes. The higher students' social comparison orientation and the more they tended toward an incremental theory, the larger the differences in ability evaluations between the low score condition and the high score condition. There were also significant order x initial ability evaluation, $F(2, 408) = 6.66$, $p = .001$, $\eta^2_p = .03$, and order x amount of social comparison information available, $F(2, 408) = 3.64$, $p = .03$, $\eta^2_p = .02$, interactions, with small effect sizes. Students with higher initial ability evaluations and with higher amounts of social comparison information available rated their abilities higher on the first evaluation and then decreased for the second and third evaluations on average, while students with lower initial ability evaluations and with lower amounts of social comparison information available rated their abilities lower on the first evaluation and then increased for the second and third evaluations on average. There was a significant effort level x order x TOI interaction, $F(2, 408) = 3.31$, $p = .04$, $\eta^2_p = .02$, with a small effect size. Students who tended toward an entity theory maintained consistently high evaluations of ability on average in the low effort condition and low evaluations of ability on average in the high effort condition, whereas students who tended toward an incremental theory changed their evaluations more on average after each piece of information was presented. Finally, there was a significant score x order x social comparison orientation interaction, $F(2, 408) = 8.05$, $p < .001$, $\eta^2_p = .04$, with a small effect size. Students with higher social comparison orientation decreased their ability evaluations more after receiving score information in the low score condition on average, and increased their evaluations more after receiving score information in the high score condition.

Calculation of difference scores. In order to examine whether participants in the task-elicited and self-initiated conditions endorsed an overall positive or inverse relation between effort and ability, I took the average value for the second evaluation (i.e., after receiving effort source information) in the high effort condition and then subtracted the average value for the second evaluation in the low effort condition. I did this calculation for both groups.

For the task-elicited group, the estimated mean for the second evaluation in the high effort condition was 3.29 (SE = .13), and the estimated mean for the second evaluation in the low effort condition was 7.04 (SE = .12). Thus, the difference score is 3.29 – 7.04 = -3.75 (Cohen's *d* of the difference between groups = 2.94). For the self-initiated group, the estimated mean for the second evaluation in the high effort condition was 5.74 (SE = .13), and the estimated mean for the second evaluation in the low effort condition was 4.61 (SE = .12). Thus, the difference score is 5.74 – 4.61 = 1.13 (Cohen's *d* of the difference between groups = .89). The fact that participants in the task-elicited condition had a negative value and those in the self-initiated condition had a positive value suggests that participants in the task-elicited condition endorsed an overall inverse relation between effort and ability, while those in the self-initiated condition endorsed an overall positive relation between effort and ability. This pattern of results supports Hypotheses 1 and 2. Additionally, the effect size of the inverse relation between effort and ability found in the task-elicited condition is larger than the effect size of the positive relation between effort and ability found in the self-initiated condition.

Study 2

Overview of the main analyses. As discussed in Chapter 3, in order to test Hypotheses 1 and 2, I ran three 3 (effort source: task-elicited, self-initiated, control) x 2 (effort level: high, low) ANCOVAs, one for each ability evaluation at each level of specificity (i.e., self-evaluations for ability on a specific fraction task, general fraction ability, and general math ability). Each analysis included five covariates: effort distance (described in Chapter 3), students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence. Before conducting the ANCOVAs, I examined mean differences on the covariates between the six between-subjects groups. Those analyses are described first, followed by each of the three ANCOVAs. I also examined main effects of the covariates on students' ability evaluations. Finally, I conducted a 3 (effort source: task-elicited, self-initiated, control) x 2 (effort level: high, low) x 3 (type of ability evaluation: task, fraction, math) ANCOVA with the same five covariates to examine whether the effects significantly differed based on the type of ability evaluation.

Mean differences on covariates for between-subjects groups. The five covariates, as discussed above, were effort distance, students' initial beliefs about their mathematics ability, their social comparison orientation, the amount of social comparison information available to them in general, and theories of intelligence. I examined whether participants in the task-elicited-low effort (N = 21), task-elicited-high effort (N = 27), self-initiated-low effort (N = 28), self-initiated-high effort (N = 27), control-low effort (N = 28), and control-high effort (N = 29) groups differed on the levels of these variables by conducting a series of one-way ANOVAs. There were no differences for effort distance, $F(5, 159) = .96$, $p = .44$, initial ability evaluation, $F(5, 159) = .96$, $p = .45$, amount of social comparison information available, $F(5, 159) = .93$, $p = .46$, or theories of intelligence, $F(5, 159) = .63$, $p = .68$, but there was a marginally significant difference for social comparison orientation, $F(5, 159) = 2.27$, $p = .05$. Post hoc tests indicated a significant difference between participants in the task-elicited, low effort condition ($M = 3.42$, $SE = .25$) and the self-initiated, low effort condition ($M = 4.15$, $SE = .10$), Tukey's mean difference $= -.74$, $SE = .24$, $p = .03$. This finding suggests that participants in the self-initiated low effort condition reported a stronger social comparison orientation than participants in the task-elicited low effort condition; no other differences were significant.

ANCOVA results: Self-evaluations for ability on the specific fraction task. There was a main effect of effort level, $F(1, 149) = 33.35$, $p < .001$, $\eta^2_p = .18$, with a medium effect size, which was qualified by an effort source x effort level interaction, $F(2, 149) = 5.45$, $p = .01$, $\eta^2_p = .07$, with a small effect size. In the task-elicited condition, participants' ability evaluations in the low effort ($M = 5.42$, $SE = .38$) and high effort ($M = 5.12$, $SE = .34$) conditions did not significantly differ, $t(46) = .59$, $p = .56$. In the control and self-initiated conditions, participants in the low effort groups (for control: $M = 6.05$, $SE = .33$; for self-initiated: $M = 6.31$, $SE = .34$) rated their abilities significantly higher than participants in the high effort groups (for control: $M = 3.66$, $SE = .32$; for self-initiated: $M = 4.14$, $SE = .34$), $t(55) = 5.20$, $p < .001$, for control, $t(53) = 4.51$, $p < .001$, for self-initiated, contrary to hypotheses (see Table 3 in Appendix C and Figure 6). These findings suggest that participants in the control and self-initiated conditions rated their abilities higher when they exerted lower effort and lower when they exerted higher effort (which is consistent with an *inverse* relation between effort and ability), whereas those in the task-elicited conditions did not.

Additionally, there was a main effect of initial ability evaluation, $F(1, 149) = 25.84$, $p < .001$, $\eta^2_p = .15$, with a medium effect size. Students with higher initial math ability evaluations rated their abilities higher on the specific fraction task at the end of the study.

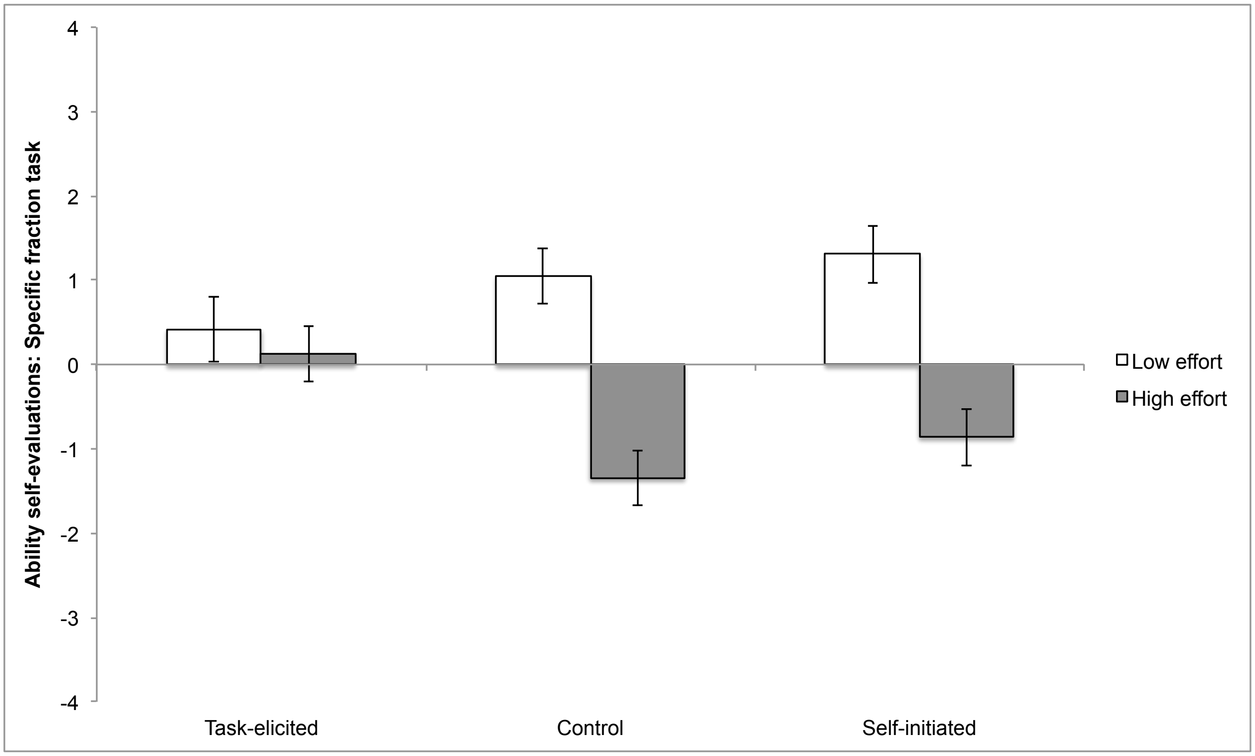

Figure 6. ANCOVA results for Study 2, specific fraction task. The y-axis represents students' self-evaluations of ability on the specific fraction task as compared to the other hypothetical student, and is centered at the midpoint. Values greater than zero indicate that the participant rated their ability higher than the "other" participant, and values less than zero indicate that the participant rated their ability lower than the "other" participant.

ANCOVA results: Self-evaluations for fraction ability. There was a main effect of effort level, $F(1, 149) = 25.38$, $p < .001$, $\eta^2_p = .15$, with a medium effect size, which was qualified by an effort source x effort level interaction, $F(2, 149) = 3.44$, $p = .04$, $\eta^2_p = .04$, with a small effect size. In the task-elicited condition, participants' ability evaluations in the low effort ($M = 5.64$, $SE = .37$) and high effort ($M = 5.30$, $SE = .33$) conditions did not significantly differ, $t(46) = .68$, $p = .50$. In the control and self-initiated conditions, participants in the low effort groups (for control: $M = 5.95$, $SE = .32$; for self-initiated: $M = 6.23$, $SE = .33$) rated their abilities significantly higher than participants in the high effort groups (for control: $M = 4.09$, $SE = .32$; for self-initiated: $M = 4.30$, $SE = .33$), $t(55) = 4.11$, $p < .001$, for control, $t(53) = 4.13$, $p < .001$, for self-initiated, contrary to hypotheses (see Table 4 in Appendix C and Figure 7). These findings again suggest that participants in the control and self-initiated conditions rated their abilities higher when they exerted lower effort and lower when they exerted higher effort (which is consistent with an *inverse* relation between effort and ability), whereas those in the task-elicited conditions did not. Because Hypotheses 1 and 2 were that participants in the task-elicited condition would rate their abilities higher when they exerted lower effort (and lower when they exerted higher effort; consistent with an inverse relation between effort and ability), and participants in the self-initiated condition would rate their abilities higher when they exerted higher effort (and lower when they exerted lower effort; consistent with a positive relation between effort and ability), these results do not support Hypotheses 1 or 2.

Additionally, there was a main effect of initial ability evaluation, $F(1, 149) = 28.44$, $p < .001$, $\eta^2_p = .16$, with a medium effect size. Students with higher initial math ability evaluations rated their fraction abilities higher at the end of the study.

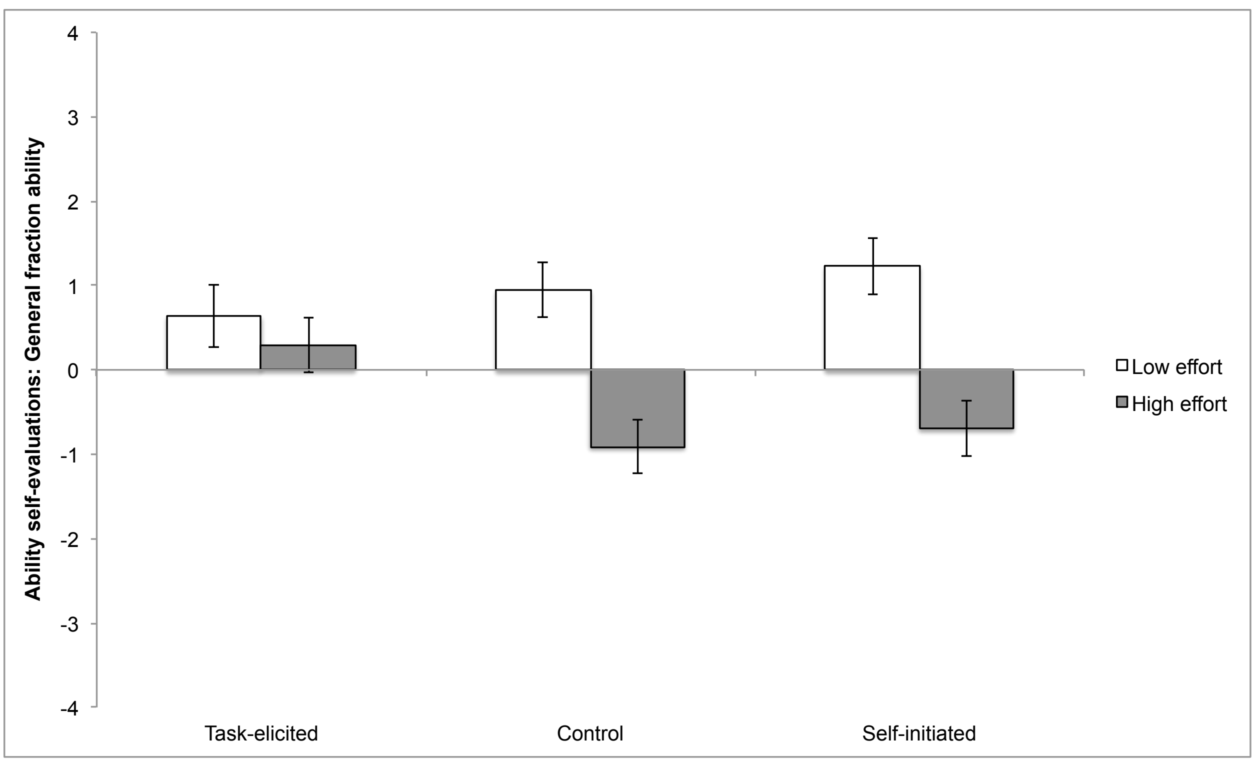

Figure 7. ANCOVA results for Study 2, fraction ability. The y-axis represents students' self-evaluations of general fraction ability as compared to the other hypothetical student, and is centered at the midpoint. Values greater than zero indicate that the participant rated their ability higher than the "other" participant, and values less than zero indicate that the participant rated their ability lower than the "other" participant.

ANCOVA results: Self-evaluations for math ability. There was a main effect of effort level, $F(1, 149) = 25.64$, $p < .001$, $\eta^2_p = .15$, with a medium effect size. Participants in the low effort conditions ($M = 5.84$, $SE = .17$) reported significantly higher self-evaluations for math ability than participants in the high effort conditions ($M = 4.65$, $SE = .16$), $t(158) = 5.10$, $p < .001$. There were no other significant main effects or interactions, although the general pattern of results was similar to the findings for self-evaluations of ability on the specific fraction task and fraction ability. In the task-elicited condition, participants' ability evaluations in the low effort ($M = 5.46$, $SE = .32$) and high effort ($M = 4.93$, $SE = .28$) conditions did not significantly differ, $t(46) = 1.25$, $p = .22$. In the control and self-initiated conditions, participants in the low effort groups (for control: $M = 5.84$, $SE = .28$; for self-initiated: $M = 6.22$, $SE = .29$) rated their abilities significantly higher than participants in the high effort groups (for control: $M = 4.37$, $SE = .27$; for self-initiated: $M = 4.64$, $SE = .28$), $t(55) = 3.78$, $p < .001$, for control, $t(53) = 3.92$, $p < .001$, for self-initiated, contrary to hypotheses (see Table 5 in Appendix C and Figure 8).

Additionally, there were main effects of initial ability evaluation, $F(1, 149) = 53.58$, $p < .001$, $\eta^2_p = .26$, with a large effect size, and social comparison orientation, $F(1, 149) = 5.83$, $p = .02$, $\eta^2_p = .04$, with a small effect size. Students with higher initial math ability evaluations and lower social comparison orientation rated their math abilities higher at the end of the study.

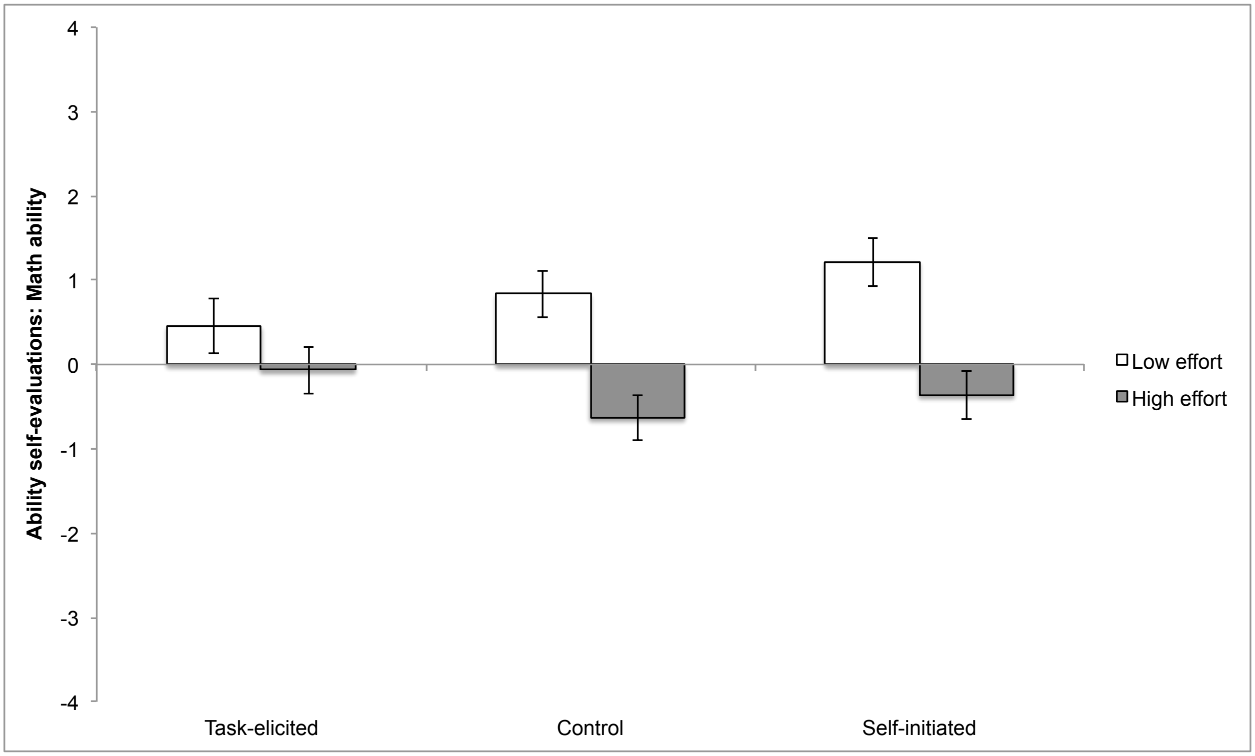

Figure 8. ANCOVA results for Study 2, math ability. The y-axis represents students' self-evaluations of general math ability as compared to the other hypothetical student, and is centered at the midpoint. Values greater than zero indicate that the participant rated their ability higher than the "other" participant, and values less than zero indicate that the participant rated their ability lower than the "other" participant.

ANCOVA results: All ability evaluations. There was no main effect of type of ability evaluation, $F(2, 298) = 1.74$, $p = .18$, $\eta^2_p = .01$, or an effort source x effort level x type of ability evaluation interaction, $F(2, 298) = 1.58$, $p = .18$, $\eta^2_p = .02$. Thus, the pattern of results did not significantly differ based on the specificity of the ability evaluations.

Chapter 5: Discussion

Overview

In this chapter, I will first discuss the results from Studies 1 and 2, and integrate these results with previous literature. I will then discuss both the theoretical and practical implications of my findings. Finally, I will discuss limitations of the present studies and ideas for future research to build on this work.

Study 1

Results from Study 1 are consistent with my hypotheses and with prior research on the impact of perceived effort source on perceptions of others' abilities (e.g., Muenks et al., in press). College students' perceived effort source influenced their perceptions of the relation between their own effort and ability in mathematics, and the effect sizes were large. Specifically, when participants were asked to imagine that their effort was due to the subjective ease or difficulty of the task (i.e., task-elicited), they evaluated their own abilities higher when they exerted less effort than the other character in the vignette, and lower when they exerted more effort than the other character. In contrast, when participants were asked to imagine that their effort arose from their own motivation or lack of motivation (i.e., self-initiated), they tended to evaluated their own abilities higher when they exerted more effort than the other character in the vignette, and lower when they exerted less effort than the other character. Thus, participants in the task-elicited condition endorsed an *inverse* relation between their own effort and ability, whereas participants in the self-initiated condition endorsed a *positive* relation between their own effort and ability. These results were found after controlling for students' initial beliefs about their math abilities, the extent to which participants are sensitive to social comparison information (i.e., their social comparison orientation), the amount of social comparison information they report is available to them in their classes, and their theories of intelligence.

In the sequential information block of Study 2 of Muenks et al. (in press), participants were given effort level, effort source, and performance information about a single character and asked to make an ability evaluation of the character after each piece of information was presented. In the present study I used a similar methodology except that instead of using a single character, I gave participants effort level, effort source, and performance information about themselves as compared to another character, and asked them to evaluate their ability after each piece of information was presented. Thus in the present study I built on Study 2 of Muenks et al. (in press) by using a similar methodology but more directly connecting participants' perceptions of effort source to their ability evaluations of themselves, which is important because self-beliefs about ability are critical influences on students' motivation (e.g., Wigfield et al., 2015). That is, because students' beliefs about *themselves* are much more proximal indicators of their motivation and choices than their beliefs about *others* (e.g., Nicholls & Miller, 1984), it is critical to make the connection between perceptions of effort source and one's own ability evaluations in order to establish the motivational importance of the effort source construct.

As expected, the results for Study 2 of Muenks et al. (in press) and the present Study 1 were very similar. In both studies, the change in ability evaluations from the first to the second ability evaluation (the latter of which was made directly after participants received information about effort source) significantly differed for participants in the task-elicited and self-initiated conditions. In the task-elicited condition, participants' ability evaluations of individuals who put forth low effort (either themselves or a hypothetical character) increased, and their evaluations of individuals who put forth high effort decreased. In the self-initiated condition, participants' ability evaluations of individuals who put forth low effort decreased, and their evaluations of individuals who put forth high effort increased.

Calculating difference scores for this study allowed me to examine whether participants perceived an overall positive or inverse relation between their own effort and ability. In the task-elicited condition, this number represents the difference in self-evaluations of ability in a situation where one perceives they worked hard because the task was difficult for them, and in a situation where one perceives they did not work hard because the task was easy for them. In the self-initiated condition, this number represents the difference in self-evaluations of ability in a situation where one perceives they worked hard because they were motivated to engage in the task, and in a situation where one perceives they did not work hard because they were not motivated. The difference score for the task-elicited condition was -3.75, which is consistent with an overall inverse relation between effort and ability, and the difference score for the self-initiated condition was 1.13, which is consistent with an overall positive relation.

Interestingly, the absolute value of the difference score for the task-elicited condition is larger than the absolute value of the difference score for the self-initiated condition. The effect size (based on adjusted means) for the task-elicited condition was also larger than the effect size for the self-initiated condition. Thus is appears that the inverse relation between effort and ability in the task-elicited condition is stronger than the positive relation between effort and ability in the self-initiated condition. This finding is consistent with Muenks et al. (in press) that found stronger evidence for task-elicited effort leading to a perceived inverse relation between effort and ability than for self-initiated effort leading to a perceived positive relation.

The differences in absolute value could have occurred for several reasons. First, the vignettes in the present study describe a social comparison situation, which is an important component of ego-involved contexts as defined by Nicholls (1984). Much work by Nicholls and colleagues (e.g., Jagacinski & Nicholls, 1984, 1987; Nicholls, 1978, 1984) has found that, on average, individuals tend to perceive an inverse relation between effort and ability in these contexts. Thus, perhaps for participants the general tendency was to perceive an inverse relation between effort and ability, which could explain why the absolute value of the inverse relation in the task-elicited condition was larger than the absolute value of the positive relation in the self-initiated condition. This is also consistent with results from Muenks et al. (in press), which showed that in social comparison situations (Studies 1a and 1b), participants were relatively unlikely to perceive a strong positive relation between effort and ability, even in the self-initiated conditions.

Furthermore, participants in the low effort condition rated their abilities higher than participants in the high effort condition after receiving information about performance outcomes (i.e., the third evaluation), regardless of their effort source condition. This implies that participants overall tend to view high effort as an indicator of low ability, and vice versa. Thus the fact that the absolute value of the inverse relation between effort and ability was larger than the absolute value of the positive relation between effort and ability is consistent with these results.

Another possibility is that it may be more straightforward for participants to associate “finding a task difficult” with low ability than “being motivated on a task” with high ability. Even very young children understand that “finding a task difficult” is an indicator of low ability (e.g., Heyman & Compton, 2006; Heyman et al., 2003). However, “being motivated on a task” is not necessarily synonymous with high ability. While it seems possible that individuals with high ability might be motivated to work hard, and individuals who are motivated to work hard might improve their abilities over time (see Muenks & Miele, under review), it is certainly also possible that individuals can be motivated to work hard on a task but still have low ability (e.g., Anderson & Butzin, 1974).

However, the difference score was positive in the self-initiated condition, in contrast to the negative difference score in the task-elicited condition. Thus participants who were told to attribute their effort to self-initiated motivation or its lack were still more likely to endorse a positive relation between effort and ability than those who were told to attribute their effort to task difficulty or ease. Findings from the present study suggest that, on average, individuals' perceptions that they worked harder on an academic task than someone else will only lead to the conclusion that they have less ability than that other person *if* they think that the reason for working hard is because the task was difficult for them. If instead individuals think that they worked harder because they were more motivated to engage in the task, they may conclude that they actually have *more* ability than the other person. The theoretical implications of these findings will be described in more detail below.

Importantly, this research does not illuminate the underlying reasons *why* perceptions of self-initiated effort lead to positive relations between levels of effort and ability. Is it because individuals who perceive that effort is self-initiated shift into a definition of ability as a set of skills or competencies (see discussion of Dweck's theory below), or does it simply reflect a naïve belief that smart people also tend to be motivated people? In the future researchers should explore these competing hypotheses in order to unpack this relation.

There was some evidence that participants used information from prior vignettes in their responses to later vignettes. Specifically, as can be seen in Figure 4, there were significant differences in the first evaluation between those in the task-elicited and self-initiated conditions that were in expected directions based on the effort source condition participants were in. This is interesting because the only information that participants received before making the first evaluation was whether they or the other character exerted more effort on the task, *not* the source of the effort. Thus participants in the task-elicited and self-initiated groups received the exact same information. However, it appears that when those in the task-elicited condition were told that they exerted less ability than the other character, they rated their ability significantly higher than participants in the self-initiated condition. And, when those in the task-elicited condition were told that they exerted more ability than the other character, they rated their ability significantly lower than participants in the self-initiated condition. It therefore seems plausible that after reading several of these vignettes participants assumed what the source of effort would be and their first evaluations fit with those assumptions accordingly. Or, perhaps after responding to a few vignettes that were specific to an effort source condition, participants developed a general view of effort and ability that influenced their responses even on the first evaluation. However, this finding is not particularly problematic to the study as a whole, as I still found robust results in the second ability evaluation, which is the evaluation of interest to my hypotheses (see Figure 5). Regardless of where participants started out on the first ability evaluation, after receiving information about the source of their effort, those in the task-elicited condition rated their abilities higher when they exerted low effort, and those in the self-initiated condition rated their abilities higher when they exerted high effort.

Furthermore these results are consistent with findings from Muenks et al. (in press) that once clear performance information is provided (i.e., who actually performed better on the task), the differences between the task-elicited and self-initiated groups become negligible (see Figure 4). Heider (1958) hypothesized that effort will improve performance up to the limit of one's ability; thus, if one knows at least two of these pieces of information (e.g., effort level, performance), he or she can make assumptions about the third (e.g., ability level). In the present study, once participants received performance information, they used that information along with effort level information to make their ability evaluations, and these two pieces of information together "trumped" any information about effort source. This is consistent with prior research showing that individuals use effort level and performance information as clear indicators of ability (e.g., Harari & Covington, 1981; Karabenick & Heller, 1976; Kun, 1977; Kun et al., 1974; Nicholls, 1978; Surber, 1980; Wimmer et al., 1982).

However, it is important to point out that in many academic situations in real life students do not have access to information about how well other students did on academic tasks (i.e., performance information). In these cases, participants may use other types of information, such as perceived effort source, to make evaluations of others' abilities, and in turn, to make evaluations of their own abilities. Thus it is still important to study how participants make self-evaluations of ability in social comparison contexts in the absence of explicit performance information.

There were also some supplemental findings from Study 1 that I will briefly mention. First, those in the task-elicited condition reported that significantly more social comparison information was available to them in school than those in the self-initiated condition (i.e., "In general, how much information is available to you about how others are doing in your college classes?"). I do not have a conjecture as to why this occurred, but perhaps it speaks to the failure of randomization in this study to equalize the two groups of participants on all extraneous variables. I ensured that this did not affect my results by using it as a covariate in all of my analyses. Second, when examining whether there were any effects of mathematics domain (calculus or statistics), only a four-way interaction was significant, and the meaning behind this interaction was not interpretable. Perhaps future studies can clarify how students' beliefs about effort and ability are different in different math-related courses at the college level. Finally, there were some main effects and interactions between the covariates (initial ability evaluations, social comparison information, amount of social comparison information available, and theories of intelligence) and the experimental conditions in the study. However, because the effect sizes of these interactions were small and none of the covariates moderated the focal interactions of interest, I will not discuss them in detail here. Future research could parse out whether some of these variables moderate the effects of effort source information on students' ability evaluations.

The results from Study 1 build on work by Koriat and colleagues (e.g., Koriat et al., 2006; Koriat & Nussinson, 2009) in several ways. First, whereas Koriat and colleagues manipulated task demands to elicit different types of effort (data-driven and goal-driven), in the present study I directly manipulated students' perceptions of the source of their own effort as either task-elicited or self-initiated using hypothetical vignettes. Second, whereas Koriat and colleagues examined students' judgments of learning (JOLs) for very specific tasks as their outcome of interest, in the present study I measured students' beliefs about their own math abilities, which are very powerful and predict a wide range of motivation- and achievement-related outcomes (e.g., Bandura & Schunk, 1981; Bouffard-Bouchard et al., 1991; Dennissen et al., 2007; Durik et al., 2006; Pajares, 1996a; Simpkins et al., 2006; Wigfield et al., 2015); this is an important extension of Koriat's work. As a whole these results were consistent with Koriat's work; in Koriat's studies data-driven effort led to negative relations between level of effort and JOLs, and goal-driven effort led to positive relations between level of effort and JOLs, while in the current study perceptions of task-elicited effort led to negative relations between levels of effort and ability, and perceptions of self-initiated effort led to positive relations between levels of effort and ability.

This study also builds on work by Heyman and colleagues (e.g., Heyman et al., 2003; Heyman & Compton, 2006) by specifically examining task-elicited and self-initiated effort. As discussed in Chapter 2, Heyman and Compton (2006, Study 1) told 5-10 year old children that two characters exerted different levels of effort on a task (e.g., "Mary finished the puzzles very quickly. Sara finished the puzzles slowly."). They had two conditions in their studies: a *task difficulty* condition (e.g., "Mary thought the puzzle was easy to do. Sara thought the puzzles were hard to do.") and an *effort* condition (e.g., "Mary hardly tried at all. Sara tried and tried."). Heyman and Compton (2006) found that in the task difficulty condition children were more likely to perceive an inverse relation between effort and ability (i.e., evaluate the character who finished puzzles more quickly as smarter) than in the effort condition.

Although Heyman and Compton's (2006) "task difficulty" condition was very similar to task-elicited effort, their "effort" condition was quite different from self-initiated effort as defined here and in Muenks et al. (in press). Specifically, in Heyman and Compton (2006), participants in the effort condition were simply told that the character worked hard, while in the present study and in Muenks et al. (in press), participants in the self-initiated condition were led to believe that effort was specifically due to one's motivation or lack of motivation. Thus, the findings from this study and Muenks et al. (in press) were consistent with Study 1 in Heyman and Compton (2006) because both the task-elicited condition and the task difficulty condition produced an inverse relation between effort and ability. However, it also builds on this work by more directly manipulating participants' perceptions of self-initiated effort. In the present study I found that perceptions of one's effort as self-initiated led to perceptions of a positive relation between effort and ability. This is an important extension of Heyman and colleagues' work on how different ways of perceiving one's effort influence evaluations of academic ability.

Finally, in this study I extend Muenks et al. (in press) by showing that perceived effort source influences students' evaluations of their *own* abilities and not just their evaluations of hypothetical others. This is a crucial step to make if I want to argue that students' perceptions of effort source are motivationally important, since students' perceptions of themselves are much more strongly tied to their own motivation than their perceptions of other people (e.g., Nicholls & Miller, 1984; Stapel & Blanton, 2004; Stapel & Koomen, 2001). As a whole, Study 1 provides important extensions to previous research on effort source.

Study 2

The purpose of Study 2 was to examine how college students' perceptions of the source of their own effort after completing *an actual academic task* influenced their self-evaluations of ability in math. I examined three levels of specificity in students' evaluations: their ability on the specific fraction task they completed, their general fraction ability, and their general math ability. For all three ability evaluations I hypothesized that participants in the task-elicited, low effort group would have higher ability evaluations than participants in the task-elicited, high effort group (consistent with an overall inverse relation between effort and ability), whereas participants in the self-initiated, low effort group would have lower ability evaluations than participants in the self-initiated, high effort group (consistent with an overall positive relation between effort and ability). I also hypothesized that participants in the control, low effort group would have higher ability evaluations than participants in the control, high effort group (consistent with an inverse relation between effort and ability), but that the mean evaluations would fall somewhere in between the task-elicited and self-initiated groups.

These hypotheses were not confirmed. For all three ability evaluations (specific fraction task, fraction ability, and math ability), there were no differences in self-evaluations between participants in the task-elicited low effort group and participants in the task-elicited high effort group (see Figures 6-8). Thus participants in the task-elicited condition did not perceive either a positive or inverse relation between effort and ability. In contrast, for the self-initiated and control groups, participants in the low effort groups rated their abilities (as compared to the other participant) significantly higher than participants in the high effort groups. Thus self-initiated and control condition participants perceived an inverse relation between effort and ability (see Figures 6-8); these effect sizes were small.

When attempting to understand these unexpected results, the first thing I did was explore the possibility that the mathematics task I used was too easy or not motivating enough, even for participants who reported working hard on the task. Although I designed the study with the assumption that not all participants would feel the same way about the task (i.e., I asked open-ended questions such as, “Why was this task difficult OR easy?” and “Why were you motivated OR not motivated to complete this task?” which allowed participants to make their own judgments about the task), I did assume that participants who viewed the task as being easy and/or unmotivating would also report exerting low effort on the task, and participants who viewed the task as being difficult and/or motivating would also report exerting high effort on the task. That way, participants in the task-elicited groups could attribute their effort or lack of effort to the difficulty or ease (respectively) of the task, and participants in the self-initiated groups could attribute their effort or lack of effort to their own motivation or lack of motivation (respectively). It would be difficult to argue that participants in the task-elicited groups perceived their own effort as task-elicited if they reported working hard but did not report that they found the task difficult. Similarly, it would be difficult to argue that participants in the self-initiated groups perceived their effort as self-initiated if they reported working hard but were not motivated to engage in the task.

In order to examine whether the mathematics task I used was too easy or not motivating enough, I coded whether participants in the task-elicited and self-initiated groups[4] reported feeling overall that the task was difficult or that they were motivated (respectively), and then examined whether their reported levels of effort corresponded with these judgments. In the task-elicited group, the first open-ended question was, "In general, why was this task difficult OR easy?" Eleven out of the 48 participants described the task as exclusively difficult (22.92%), 19 participants described the task as exclusively easy (39.58%), and 18 participants described the task as being both difficult and easy (37.50%). The average effort rating was 6.09 (SD = 2.07) for participants who described the task as exclusively difficult, 5.00 (SD = 2.16) for participants who described the task as being exclusively easy, and 5.63 (SD = 2.03) for the participants who described the task as being both easy and difficult. Thus, although participants as a whole did not seem to find the task particularly difficult, the participants who reported exerting more effort described the task as being more difficult, while the participants who reported exerting less effort described the task as being easier.

In the self-initiated condition, the first open-ended question was, "In general, why were you motivated OR not motivated to complete this task?" Again from students' answers on this question I could code whether they were generally motivated or not motivated on the task. Only 5 out of the 55 participants (9.09%) reported feeling exclusively unmotivated, while 44 reported being exclusively motivated (80%) and 6 reported being both motivated and unmotivated

[4] Recall that I did not give participants in the control group any open-ended questions, so they are not included here.

(10.91%). The average effort rating was 5.80 (SD = 2.95) for participants who reported being exclusively unmotivated, 6.43 (SD = 2.15) for participants who reported being exclusively motivated, and 6.17 (SD = 1.72) for participants who reported being both motivated and unmotivated. Thus, participants as a whole seemed motivated to engage in the task, and higher effort corresponded with higher motivation. Based on these analyses, I can conclude that participants' level of effort did correspond with their reports of difficulty/ease of the task (in the task-elicited groups) and motivation/lack of motivation (in the self-initiated groups). Thus I can be fairly confident in asserting that the unexpected results for Study 2 did *not* occur simply because the task was too easy and/or unmotivating for all participants.

Interestingly, there were participants in the task-elicited condition who reported feeling that the task was *both* easy and difficult, and participants in the self-initiated condition who reported feeling *both* motivated and unmotivated to engage in the task. Although I did not originally intend to code these open-ended questions, these findings do lead to questions about whether students do in fact perceive ease/difficulty or lack of motivation/motivation along a continuum, or whether it is possible to perceive both "extremes" simultaneously. If so, the relation between perceived effort source and self-evaluations of ability may be more complex than originally thought. In the future, researchers could delve into this more deeply.

Next I investigated three additional possibilities that could describe the unexpected findings: (1) the open-ended questions in the self-initiated condition primed participants to think about social comparison and normative evaluation; (2) the open-ended questions gave participants in the task-elicited high effort group but not the self-initiated high effort group something tangible to attribute their effort to beyond their abilities; and (3) the priming sentences at the beginning of the study could have influenced participants' ability evaluations in unexpected ways.

A first possible explanation for Study 2's unexpected results is that the open-ended questions influenced how sensitive participants were to social comparison information, which then affected how they evaluated their abilities compared to the "other" participant. Nicholls (1984) theorized that as social comparison and normative evaluation become more salient in a particular context, students are likely to perceive these contexts as *ego-involved*, and view high effort as a sign of low ability (i.e., an inverse relation between effort and ability). I found in Study 2 that the content of the open-ended questions influenced the extent to which participants mentioned social comparison and normative evaluation in their responses. In particular, participants in the self-initiated groups (who were asked what made them more or less motivated during the task) were much more likely to bring up social comparison or normative evaluation than participants in the task-elicited groups (who were asked what made the task easy or difficult). Only 1 out of the 48 (2.08%) participants in the task-elicited groups mentioned social comparison or normative evaluation ("This task would have been easier for me personally if there were not other people in the room"), whereas 11 of the 55 (20%) participants in the self-initiated groups mentioned social comparison or normative evaluation. In the self-initiated groups participants wrote things like, "My motivation was increased when another participant came into the room to do the same study. I wanted to make sure I did not seem like I was struggling or for her to get ahead of me when I got here well before she did", "I would have been more motivated during the task if there was a reward for doing well or a ranking of performance. I strive to be in the top, so if I knew I was being ranked then there would have been an extra incentive to do well", and "Wanting to complete it within 30 minutes since that was the ‘average’ time. I do not want to be ‘below average’/take longer than the average. I placed a competitiveness in the task when there wasn’t necessarily a reason to.” Thus, it appears that asking participants about what made them more or less motivated to complete the task in some cases led participants to focus on social comparison, competition, and normative evaluation, while asking participants what made the task easy or difficult for them did not elicit these same kinds of responses.

Further evidence for this point comes from the social comparison orientation scale that participants completed at the end of the study. As discussed in Chapter 4, participants in the self-initiated low effort condition reported a stronger social comparison orientation than participants in the task-elicited low effort condition (i.e., they were more likely to agree with statements such as, “I often compare myself with others with respect to what I have accomplished in life”). Because social comparison orientation was measured at the end of the study, the direction of this relation is not clear (i.e., Did participants who were more oriented toward social comparison to begin with just happen to be placed in the self-initiated groups, or did the self-initiated open-ended questions prime participants to think more about social comparison, and thus affect their responses on the questionnaire?). Either way, this is a potential explanation for the unexpected results for Study 2. Specifically, because participants in the self-initiated groups were more attuned to social comparison, they were also more likely to perceive that they were in an ego-involved context (e.g., Butler, 1987, 1988; Jagacinski & Nicholls, 1984, 1987; Nicholls, 1984). This may explain why they rated their abilities much lower than the “other” participant when they were told they worked harder than the other participant (and, conversely, why they rated their abilities much higher when they were told they worked less hard). In contrast, participants in the task-elicited groups were not attuned to social comparison and were therefore less likely to perceive that they were in an ego-involved context (e.g., Butler, 1987, 1988; Jagacinski & Nicholls, 1984, 1987; Nicholls, 1984). This may explain why they did not necessarily rate their abilities much lower or much higher than the "other" participant when they were told that participant worked harder or less hard than they did.

A second possible explanation has to do with attributions for effort in the task-elicited groups. It could be that asking participants to report what specifically about the task was difficult for them allowed them to think more deeply about their challenges with the task, and thus, were able to "explain" the high levels of effort they needed to exert. For example, when participants in the task-elicited conditions were asked what specific aspects of the task were most difficult, they wrote things like, "converting improper fractions to mixed numbers", "dealing with larger numbers in the fractions", and "dealing with unusual fractions." Perhaps giving participants this opportunity to write about their challenges allowed them to maintain high evaluations of their abilities even when told that they worked harder than the other participant. For example, participants in the task-elicited high effort group may have thought something like, "I know I worked hard on this task, but it is not because I am bad at fractions. It is just because I am not used to converting improper fractions to mixed numbers." In this sense they were able to *attribute* their hard work to more specific skills that might be lacking. Because participants in the self-initiated and control groups did not have this same opportunity, they may have just assumed that if someone worked less hard than they did, that other person was better at fractions or math than they were. This explanation is consistent with work by Weiner (1986) that being able to attribute failures to an external source can allow students to maintain high self-concepts of ability. Although participants in this study do not experience a failure per se, they still may feel negatively about their abilities if they are told they had to exert more effort on the task than someone else (e.g., Nicholls & Miller, 1984). Thus, the open-ended questions gave participants in the task-elicited high effort group something tangible to attribute their effort to, which meant that their self-evaluations of ability were not negatively affected by the fact that they worked harder than the "other" participant.

A third possible explanation is that the short priming sentence at the beginning of the study ("A lot of people work hard on this task because it is difficult" in the task-elicited condition, "A lot of people who hard on this task because they feel motivated to complete it" in the self-initiated condition, and "A lot of people work hard on this task" in the control condition) influenced the results. Specifically, participants in the task-elicited condition (but not the self-initiated or control conditions) were told that *others* find the task difficult. Thus, these participants may have maintained more positive evaluations of their abilities even when they were told that they worked harder than someone else, because they assumed that most other people (perhaps even the person they were comparing themselves to) also found the task difficult.

There are some additional differences between the two studies that I should point out. Although I do not have specific hypotheses as to why these differences could have contributed to the unexpected findings in Study 2, researchers should keep these differences in mind when designing future studies on effort source. These differences include: (1) Explicit versus implicit manipulation of effort source; (2) Perceiving effort source in oneself versus others; and (3) Imagining doing a task versus actually doing a task.

First, it is possible that the results differed between the two studies because in Study 1 effort source perceptions were *explicitly* manipulated with vignettes, whereas in Study 2 effort source perceptions were more *implicitly* manipulated with open-ended items. Given that real classroom contexts are probably more similar to Study 2 (i.e., participants likely form perceptions of effort source implicitly rather than explicitly), and that the findings of Study 2 did not support our hypotheses, there is clearly a lot of work that researchers need to do in order to better understand how perceptions of effort source occur in real-world settings.

Second, it seems likely that there are differences in how individuals perceive the source of their *own* effort versus the source of someone *else's* effort. In Study 1 I manipulated students' perceptions of the source of their own and others' hypothetical effort, whereas in Study 2 I manipulated students' perceptions of the source of their *own, actual* effort (and did not manipulate their perceptions of others' effort). When students are thinking about their own effort, such as in Study 2, perceptions of task-elicited and self-initiated effort may be more overlapping (e.g., "This task is too hard so I am not motivated to complete it"), whereas it may be easier for students to perceive *others'* effort as coming from only one source or the other. This relates to the literature on differences between "self" and "other" attributions that suggests that these attribution processes are similar in some ways but distinct in others, since individuals tend to have more information about themselves (e.g., thoughts, perceptions, emotions) than they do about others (e.g., Nicholls & Miller, 1984; Smith, 1984).

Third, there are differences between *imagining* doing a task (as in Study 1) and actually *doing* a task (as in Study 2). When students read a vignette, they are only getting the information that is explicitly laid out in the vignette. However, when students actually do a task, they are getting a lot of additional information about their performance, their feelings while doing the task, their physiological states, and so on. This could affect how sensitive they are to experimental manipulations. Perhaps in Study 2 I was not able to manipulate participants' perceptions of effort source because students had already formed strong perceptions, assumptions, and beliefs about the task while they were actually engaged in it. In the future researchers should think of ways to design studies that will mitigate this problem or will allow more insight into the complexities of students' perceptions and thoughts while they are actually doing a task.

Although the effort source x effort level x type of ability evaluation interaction was not statistically significant and the effect size was small, it appeared that the results were stronger (i.e., the F values were larger) for more specific evaluations of ability (i.e., specific fraction task, fraction ability) than for more general evaluations of ability (i.e., math ability). This likely occurred because the participants only received feedback about the *specific* fraction task (e.g., "The other participant finished the task approximately five minutes faster than you"), rather than their fraction or math abilities more generally. This finding is consistent with work emphasizing the importance of specificity in self-judgments of academic abilities (e.g., Pajares, 1996b). Although results for evaluations of general math ability were not statistically significant, the pattern of results was similar to those for the other two ability evaluations (see Figures 6-8) that were contrary to expectations. Additionally, for all three evaluations of ability, there were main effects for initial ability evaluation; participants who rated their initial math ability higher also rated their task, fraction, and math abilities higher at the end of the study. Furthermore, participants with a lower social comparison orientation rated their math abilities higher, on average, than participants with a higher social comparison orientation. I did not examine whether any of the covariates moderated the effects in the present study; future researchers should explore this question.

In summary, results for Study 2 were contrary to prediction. These unexpected findings could have occurred for the reasons just described or possibly others. Future research should explore which, if any, of these possible explanations receive the most support.

In Study 2 I built on previous research on effort source (e.g., Heyman et al., 2003; Heyman & Compton, 2006; Koriat et al., 2006; Koriat & Nussinson, 2009; Muenks et al., in press) in similar ways to Study 1, but also extended Study 1 by having participants complete an academic task and connect their actual effort on this task to a particular source. This is an important extension to the vignette work because it provides more ecological validity, as it is more similar to what students will experience in "real" classrooms. However, given that the results from Study 2 were unexpected and inconsistent with hypotheses, it is not clear whether I was successful at manipulating students' perceptions of the source of their own effort. Thus, I hesitate to make any strong conclusions about the extent to which students' perceptions of the source of their own effort on a task influence the perceived relation between levels of their own effort and ability.

In the future, researchers should think of new ways to explore this question. Perhaps task-elicited effort could be manipulated through facial expressions that lead to the perception that one is struggling with a task (e.g., Koriat & Nussinson, 2009; Miele & Molden, 2010; Stepper & Strack, 1993), and self-initiated effort could be manipulated by providing participants with some kind of external reward. Researchers could also use a similar paradigm of having participants respond to open-ended items, but include a manipulation check at the end to investigate whether the manipulation was successful or not. Additionally, researchers could simply measure (rather than manipulate) participants' perceptions of the source of their own effort and examine whether these perceptions are related to their ability evaluations. Further research is needed to help clarify the role of students' perceptions of effort source on their self-evaluations of ability in more "real-world" contexts.

Next I will turn to theoretical implications of the present set of studies.

Theoretical Implications

Findings from the present studies provide support for and extensions of a number of different theories in the developmental, educational, social, and cognitive psychology literatures. I will discuss each of these theories in turn with respect to how the present studies relate to them.

Social comparison theory. Participants in the present studies were asked to make self-evaluations of ability compared to another hypothetical student. I was particularly interested in these social comparison evaluations because, as discussed in Chapter 2, many researchers have found that college students use information about their peers, such as their beliefs or observations about the level of their peers' effort and ability, to form their own self-assessments (e.g., Festinger, 1954; Wheeler & Suls, 2005). These studies provide support for the idea that perceived effort source is yet another variable that college students use in social comparison contexts to form evaluations of their own abilities. For example, when students are trying to determine how good they are at a particular task (e.g., their geometry homework), they may compare themselves with other students by thinking about *why* they or others worked hard (or not), in addition to how *much* effort they and others exerted on the task. This information may allow students to make more accurate judgments about their abilities compared to others.

Attribution theory. Findings from these studies provide several important extensions to attribution theory. First, in these studies I separated out the "intention" aspect of effort from the "exertion" aspect that Heider (1958) discussed in his original attribution theory. Specifically, the perceived source of one's effort is similar to Heider's (1958) conception of intention, which is defined as the reasons for working hard. In the present studies individuals' perceived effort source (i.e., intention) influenced the perceived relation between levels of effort (i.e., exertion) and ability. Thus, in the present studies I tested a model that separated out the two components of effort that Heider (1958) originally identified, and looked at how these two components interacted to predict perceptions of ability. Results of these studies therefore suggest that perceptions of the intention behind one's effort (i.e., effort source) influence the perceived relation between effort exertion and ability level; this is an important extension of Heider's (1958) theory.

Furthermore, results of these studies are relevant to Weiner's (1986) attribution theory in which he categorizes effort, ability, task difficulty, and luck (the four most common attributions for academic success or failure) along particular dimensions. As I discussed in Chapter 2, Weiner (1979) defined immediate effort as being internal and unstable, and stable effort as being internal and stable. However, I found that there are other ways in which people can think about immediate effort (note that from now on when I talk about "effort" I mean immediate effort as defined by Weiner [1979]). As Weiner stated effort itself is internal and controllable in the sense that individuals have personal control over how *much* they exert at any given time. However, results of the present studies suggest that effort can be perceived as primarily *arising* from either the subjective ease or difficulty of the task (which is more external and uncontrollable) or their own motivation (which is more internal and controllable). Thus students' perceptions of the *source* of one's effort may differ somewhat from how immediate effort was originally delineated along the three dimensions in Weiner's (1986) theory. One way that this theory could be modified is by differentiating between perceptions of *how* someone works hard and *why* someone works hard. These two components of effort can be characterized along different dimensions. Although the act of actually exerting effort or energy on a task is clearly internal (which is consistent with the way Weiner originally defined it), perceptions of effort *source* may be more internal (self-initiated) or more external (task-elicited). Thus these findings suggest that there are multiple components to effort that should be categorized differently using Weiner's (1986) dimensions. Again this is consistent with Heider's (1958) theory in which he differentiated between effort intention and effort exertion.

Similarly, in his theory Weiner (1986) described ability as being internal, stable, and uncontrollable. However Nicholls' (1984) and Dweck's (1999) work, among others, suggests that there are differences in how individuals define or conceptualize ability across contexts, which suggest a modification of Weiner's (1986) theory. Although some people do believe that ability is stable and uncontrollable, others believe that ability can be *changed* by effort, and therefore is unstable and controllable. In the present studies I made the assumption based on Nicholls' and Dweck's work that not everyone perceives the relation between levels of effort and ability in the same way that Weiner (1986) originally conceptualized them; Weiner (1985) also recognized this possibility (p. 551). In particular I found that perceived effort source can affect individuals' perceptions of the relation between effort and ability, and thus the way that they define ability on the stable/unstable and controllable/uncontrollable dimensions, in particular contexts. Thus perhaps Weiner's (1986) theory could be modified to include the possibility that there are individual differences in how ability is characterized along his dimensions. There is evidence that attribution theorists do allow for this possibility; in Graham and Williams (2009), the authors state:

> For attribution theorists, it is the three dimensions that are constant; the placement of a cause along a dimension will certainly vary between individuals. This is not a problem

for the theory. For example, effort can be judged as quite stable when it takes on a trait-like quality (think of the attributions we make about the chronically lazy student). Similarly, ability can be perceived as unstable if perceivers believe that new learning can change one's basic abilities. Carol Dweck's research on theories of intelligence (see Dweck & Master, this volume) maps closely onto an attributional analysis of ability as stable versus unstable. (Graham & Williams, 2009, p. 14)

Nicholls' theory of ability conceptions. As discussed in Chapter 2, Nicholls' (1978, 1984) theory of ability conceptions has two components: A developmental component, and a situational/contextual component. Although many researchers (e.g., Harari & Covington, 1981; Karabenick & Heller, 1976; Kun, 1977; Kun et al., 1974; Nicholls, 1978; Surber, 1980; Wimmer et al., 1982) found clear developmental progressions in children's understanding of the relation between effort and ability, there was some debate in the literature about when children become able to fully differentiate between effort and ability and thus conceptualize an inverse relation between the two. In the present studies I chose to use a college student sample in order to ensure that all of the participants were cognitively mature enough to understand both a positive and an inverse relation between effort and ability, so that developmental level was not a confounding factor in my results. However, because I utilized a college student sample in the present studies, I am not able to contribute anything to the debate on when exactly children can conceptualize an inverse relation between effort and ability. I can only conclude that by late adolescence/early adulthood, students are able to conceptualize both a positive and inverse relation between effort and ability.

The second part of Nicholls' theory is the situational component. Nicholls (1984) argues that the context or situation a student is in (such as a classroom) can influence how they conceptualize ability. Specifically, an ego-involved situation that is characterized by an emphasis on competition and social comparison will promote a differentiated conception of ability and thus an inverse relation between levels of effort and ability, while a task-involved situation that is characterized by an emphasis on individual skill development will promote an undifferentiated conception of ability and a positive relation between effort and ability (e.g., Jagacinski & Nicholls, 1984, 1987). The contexts in both of the present studies were ego-involved in that they involved direct social comparison between two individuals, the participant themselves and hypothetical "other" participant. However, there were still differences in how participants perceived the relation between effort and ability based on effort source condition. Thus the present studies build on Nicholls' work by showing that even within an ego-involved context college students can perceive a positive relation between effort and ability (and thus conceptualize ability as undifferentiated from effort), if they *also* perceive that their own and others' effort is self-initiated (see also Muenks et al., in press). These findings suggest that perhaps Nicholls' (1984) theory could be extended to include other types of variables (such as effort source) that influence students' perceptions of the relation between effort and ability, above and beyond the context or situation they are in. More theoretical extensions of the present studies to both Nicholls' (1984) and Dweck's (1999) theories will be discussed after I talk about Dweck's theory.

Dweck's theory of individual differences in beliefs about intellectual ability. Dweck (1999) suggested that there are somewhat stable differences in how individuals conceptualize intellectual ability. Some individuals hold an entity theory and believe that ability is innate, fixed, and unaffected by effort. They are likely to endorse an inverse relation between effort and ability. Others hold an incremental theory and believe that ability is malleable and can be substantially improved with effort. They are likely to endorse a positive relation between effort and ability. In the present studies I was not interested in directly testing how students' theories of intelligence related to their perceived effort source; I therefore decided to control for theories of intelligence in my analyses. However, future research could explore the extent to which theories of intelligence might influence, or be influenced by, perceived effort source. Specifically, it seems possible that students' theories of intelligence might influence how they perceive the source of their own or others' effort. Perhaps students who hold entity theories are more sensitive to task-elicited information than those who hold incremental theories because they view task-elicited effort as a sign that someone has reached the limits of his or her ability. Students who hold incremental theories, on the other hand, might be more sensitive to self-initiated effort information because they view self-initiated effort as a sign that someone is seeking to improve his or her ability. Additionally, as discussed above, it seems possible that effort source information may at least temporarily change students' theories of intelligence. Perhaps perceiving that someone exerted high levels of task-elicited effort leads to the conclusion that his or her ability is fixed (because the task is too hard for that person), while perceiving that someone exerted high levels of self-initiated effort leads to the conclusion that his or her ability is malleable (because that person is choosing to exert effort beyond what is required by the task). In the future, researchers should explore to what extent individuals' theories of intelligence might relate to their perceptions of task-elicited or self-initiated effort (see Muenks & Miele, under review).

Overall, the most important way that the present studies build on both Nicholls (1984) and Dweck's (1999) theories is by focusing on aspects of *effort* that might influence how college students conceptualize the relation between effort and ability in specific school contexts, and thus, how they evaluate their own abilities as compared to others. As discussed in Chapter 2, both Nicholls (1984) and Dweck (1999) emphasize the impact of developmental, contextual, and individual difference factors on students' conceptions of *ability* (i.e., differentiated/undifferentiated or entity/incremental), and how their conceptions of ability then influenced how they viewed the relation between effort and ability in particular situations. However, only a few studies have examined how students' perceptions of *effort* influence this perceived relation (e.g., Heyman & Compton, 2006; Heyman, Gee, & Giles, 2003; Muenks et al., in press), and only one set of studies has examined *perceived effort source* (Muenks et al., in press). The findings of these studies suggest that above and beyond the context one is in (i.e., ego-involved or task-involved) or one's theories of intelligence (i.e., entity or incremental), perceived effort source does in fact influence how students view effort in relation to ability and thus, how they evaluate the level of their own abilities in academic contexts. This provides a critical step forward for both theories by introducing a new construct that researchers should consider incorporating into future studies. I hope that this study will encourage researchers to go beyond a one-dimensional view of effort and consider the idea that every student does not think about the source of effort in the same way, and that these different ways of thinking about the source of effort can influence motivationally important constructs such as students' beliefs about their own abilities.

Educational Implications

The present studies fall under the category of "basic research" and so do not have immediate applications to educational practice regarding how to enhance students' ability beliefs or motivation more generally. I am therefore hesitant to overstate the educational implications of this work. However, I do think that there are possibilities for future research to build on this work with the goal of applying what we have learned about the way effort source information influences individuals' judgments of their own and others' ability to motivation interventions. Once researchers better understand the extent to which students' perceptions of effort source influence their motivation, behaviors (i.e., persistence), and achievement, they could create new interventions or modify existing interventions designed to improve students' perceptions of effort in adaptive ways.

For example, there are already many interventions designed to increase students' "growth mindsets" or entity theories (e.g., Blackwell et al., 2007; Donohoe, Topping, & Hannah, 2012). In these interventions researchers teach children that their abilities are malleable and able to improve with effort. They emphasize that students should not be afraid of or shy away from working hard or exerting high effort on challenging academic tasks. Results from Study 1 suggest that it may be important to not only emphasize the benefits of working hard, but also students' perceptions about why they are working hard. If students could think about their effort as being self-initiated rather than task-elicited in contexts where they work hard, and as task-elicited rather than self-initiated in contexts where they do not work hard, they may be able to maintain positive beliefs about their competence, especially when comparing themselves to others. However, researchers will need to do more work on which effort source perceptions are most motivationally beneficial in different contexts before implementing any interventions that include effort source in them. At the moment, especially considering the different results found in Studies 1 and 2, I would not recommend that researchers jump to any definitive conclusions about which perceptions are most adaptive for students. The present studies can help us better understand how students form evaluations of their own abilities, and specifically the role of effort source perceptions to these motivationally-important beliefs, but this work does not directly tie students' beliefs about effort source to behavioral (e.g., persistence) or achievement outcomes. Researchers need to make these links before creating new interventions or modifying old ones. This is an important area for future study (see below).

Interestingly, results from Study 2 suggest a potential place for intervention that might help college students maintain high self-evaluations of ability in situations where they perceive they had to work harder than someone else on a task. Specifically, in the task-elicited condition of Study 2, participants wrote about what aspects of the fraction math task were easy or difficult for them, and what would make the task easier or more difficult. Responding to these open-ended items seemed to improve students' self-evaluations of ability in the task-elicited, high effort group (as compared to those in the control, high effort group and the self-initiated, high effort group; see Figures 6-8). Thus, even though results from this study were unexpected, it seemed that having participants write about aspects of the *task* (as opposed to writing about their motivation or not writing at all) led to more positive self-evaluations of ability in situations where they were told that they worked harder than someone else. This finding suggests that writing about why a task was easy or difficult for students might mitigate the negative effects of finding out that they exerted more effort than someone else on the same task. As discussed above, this could have occurred because writing about the task might have primed a task-involved or mastery-oriented mindset (e.g., Nicholls, 1984) or because writing about the task gave participants attributions for their hard work that did not reflect poorly on their self-evaluations of ability. Future studies should continue to explore this effect. If it continues to hold, this could be another area for potential intervention.

Limitations

The present studies have several limitations. I will begin with limitations that involve both studies, and end with specific limitations of each study individually. First, for both studies I utilized college student samples from a large, public, mid-Atlantic university that were majority female (67.8% in Study 1 and 78.1% in Study 2). Thus, my findings are not generalizable to younger students (middle school, high school) or to students from different areas of the United States or the world. Furthermore, I may have had different results had I had more gender-balanced samples or sample of majority men, especially because many researchers have found differences in male and female college students' perceptions of their mathematics abilities (Sax, Kanny, Riggers-Piehl, Whang, & Paulson, 2015). Indeed, in the present studies, men initially rated their math abilities significantly higher than women, $t(206) = 2.88$, $p = .004$, for Study 1, $t(158) = 3.27$, $p = .001$, for Study 2. However, I controlled for this in the following ways: 1) by having participants in both studies compare their abilities to another student of the same gender; and 2) by controlling for students' initial beliefs about their mathematics abilities.

Despite these limitations, I do believe that these samples were appropriate for the studies for several reasons. First, as discussed in Chapter 2, college students' beliefs about their academic abilities are particularly important predictors of their adjustment to college, grades, retention, and career prospects (e.g., Chemers et al., 2001; Lent et al., 1986; Robbins et al., 2004; Zajacova et al., 2005). Thus it is important for researchers to more deeply explore how college students form evaluations of their own abilities, which is why I chose college students as my population of interest. Second, despite the fact that the samples were not fully gender balanced, they were diverse in other ways. Specifically, both samples were quite ethnically diverse and also diverse in terms of students' majors. The ethnic breakdown of students at the University of

Maryland is 53.4% White, 15.4% Asian, 12.5% Black, 8.8% Hispanic, and 9.9% Other (Forbes, 2016). The ethnic breakdown of Study 1 was 38.6% White, 22.9% Asian, 26.2% Black, 5.2% Hispanic, and 7.1% Bi-racial or multi-racial, and the ethnic breakdown of Study 2 was 52.5% White, 25% Asian, 10.6% Black, 4.4% Hispanic, and 7.5% Bi-racial or multi-racial. Thus although both samples somewhat oversampled Black and Asian students and somewhat undersampled Hispanic and White students, the overall ethnic breakdown was quite representative of University of Maryland students as a whole. Furthermore, in both studies Behavioral and Social Sciences was the most common category of majors for participants, but only 24.3% of the participants in Study 1 majored in Behavioral and Social Sciences, and only 36.3% of participants in Study 2 did. Thus, my samples included a majority of students who were not Behavioral/Social Science majors.

Another limitation of the present studies is that they do not demonstrate that students spontaneously generate perceptions of effort source on their own in real classroom contexts. In Study 1 I told participants in the vignettes what information to focus on, which forced them to perceive effort in a particular way. I also forced them to make an ability evaluation. Although the vignettes were meant to describe realistic school-based scenarios, participants read these vignettes in a laboratory and it is certainly possible that they never actually experienced the situations described in the vignettes in their real lives. Participants may have been attuned to the information I provided them, and responded accordingly. However, they may not have actually held these effort source perceptions about themselves or other students had I studied this phenomenon in real classrooms. Aguinis and Bradley (2014) state, “One of the major criticisms regarding the use of Experimental Vignette Methodology (EVP) is that it is unrealistic and not easily generalizable… In fact, EVT studies are criticized for only showing that certain outcomes *can* happen but not necessarily that they *do* happen outside of the experimental situation" (p. 361, emphasis in original). Thus, a next critical step in research on perceived effort source is to study whether students form these perceptions naturally or spontaneously on their own in real-world school contexts. Perhaps certain cues, such as students appearing outwardly discouraged or frustrated, would lead to the assumption of task-elicited effort, and other cues, such as students appearing enthusiastic about a task, would lead to the assumption of self-initiated effort. Additionally, perhaps students only use effort source information in situations where they experience a surprising or unexpected outcome (i.e., failing a test when they thought they would do well). In these cases students may be particularly motivated to look to their peers and use information about effort source and effort level in order to understand why the surprising outcome occurred. In the future researchers should challenge themselves to move beyond vignettes and explore how these processes work in real school contexts. Qualitative work might be particularly helpful in this regard.

In Study 2 I tried to place participants in a more "real-world" situation by having them complete an actual task. However, this study occurred in a laboratory and I still manipulated perceptions of effort source rather than measuring whether students perceive their own and others' effort as task-elicited or self-initiated naturally. Thus I was not able to conclude whether participants spontaneously generate these perceptions on their own.

An issue that is always potentially problematic in psychological research is that self-reports may be biased due to social desirability (e.g., Krumpal, 2013). Perhaps participants in Study 1 picked up on the differences in the vignettes and figured out what I "wanted" them to report, and responded accordingly (even if that is not how they would respond in "real-world" situations). It is difficult to test this or to know whether this occurred; in the future researchers could try to design studies that minimize the influence of social desirability on participants' responses, perhaps through more observational-based methods. I am less concerned about social desirability effects in Study 2 for two reasons. First, participants across all three effort source conditions were given the same effort level information and made the same ability evaluation. The only differences between the three conditions were the short priming sentence at the beginning of the task (e.g., "A lot of people work hard on this task because…") and the open-ended questions they responded to, which I doubt most participants would pick up on as being an important part of the manipulation. Second, the results from this study were unexpected and inconsistent with my hypotheses, so it is highly unlikely that participants correctly "guessed" what I was looking for and responded accordingly.

Another possible limitation of Study 1 specifically is that students may have experienced fatigue due to responding to eight somewhat similar vignettes. However, I did make minor changes to the vignettes in order to reduce repetition. I also include a distractor task in the middle of these vignettes (i.e., I asked participants to name as many state capitals as they could in two minutes) in order to minimize this concern. Additionally, many studies have found that college students (and children) can handle multiple similar vignettes in a row (e.g., Harari & Covington, 1981; Kun et al., 1974; Kun, 1997; Surber, 1980). Thus, I feel confident that the participants in my study read the vignettes carefully.

A limitation of Study 2 is that there was no manipulation check. Thus, I am unable to conclude whether the study did not work out as expected because I was simply unsuccessful at manipulating students' perceptions of effort source, or because my hypothesis was incorrect. It would have been very helpful if I had included, at the end of the study, a question that participants had to respond to such as, "My effort or lack of effort on this task was mostly driven by…" (1 = the ease/difficulty of the task to 10 = my own motivation/lack of motivation). I could have then examined whether participants in the task-elicited condition were more likely to report that they perceived their own effort as task-elicited, and participants in the self-initiated condition were more likely to report that they perceived their own effort as self-initiated. In the future, researchers should think about building manipulation checks into the designs of their studies on perceived effort source, especially when trying to manipulate these perceptions in novel ways.

Another limitation of Study 2 is that I did not measure math anxiety. Given that I had a majority female sample, and that females are more likely than males to experience math anxiety (e.g., Goetz, Bieg, Lüdtke, Pekrun, & Hall, 2013), it is likely that there were participants in my sample that had high levels of math anxiety. These participants may have approached the fraction task very differently than participants with lower levels of math anxiety, and relations between perceived effort source and self-evaluations of ability could be different for this group. Specifically, perceptions of task-elicited effort may have been particularly salient for these highly anxious students, whereas perceptions of self-initiated effort may not have been salient; this could have affected the strength of the relation between perceptions of effort source and perceptions of the relation between effort and ability. Although randomization to groups should control for these differences, in the future researchers could either explicitly control for math anxiety or look at math anxiety as a moderator of the relations between variables. Furthermore, although I tried to minimize the experience of stereotype threat by not having participants report their gender before engaging in the task, it is possible that stereotype threat could have still affected the women in my sample; future research could further explore this.

Finally, it is possible that the recipe fraction task in Study 2 was simply not motivating for college students, especially for men, in the way I intended it to be. It is possible that many college students do not cook regularly and so they may not see a recipe fraction task as being particularly relevant to their daily lives. Thus their motivations on the task were likely more driven by social comparison/competition (see above) than actual interest in the task itself. Asking participants to complete a more interesting or motivating task may have made it easier for me to manipulate participants' perceptions of their effort as being self-initiated. However, as discussed above, participants did appear to be generally motivated on the task, just perhaps for different reasons than I expected them to be. See below for more discussion of "motivation" in the self-initiated condition.

Remaining Questions and Future Directions

As discussed in this chapter, I believe these studies made critical empirical contributions to the current literature on students' perceptions of the relations between effort and ability. However, there are still many unanswered questions that future research should address to replicate, extend, and build on this work.

One important remaining question is: Is it possible for one's effort to be task-elicited and self-initiated at the same time? It certainly seems possible, and very likely, that students' effort is both task-elicited and self-initiated when they are completing many academic tasks. In the present set of studies I argue that one's effort can be perceived as *primarily* task-elicited or self-initiated in a particular context or situation, and that these perceptions influence how students conceptualize the relation between effort and ability in those contexts. However, in the future researchers should study these perceptions in more ecologically valid contexts, such as real classrooms, and whether students' perceptions do in fact differ across different situations. For example, are there particular classrooms where students perceive their own or others' effort as primarily task-elicited? Are there other situations where students perceive their own or others' effort as primarily self-initiated? Or are students' perceptions of their effort always an equal balance between being task-elicited and self-initiated? What are the implications of these different perceptions?

Another remaining question is whether the "motivation" component of self-initiated effort can or should be separated into different components of motivation, such as intrinsic and extrinsic motivation (e.g., Deci & Ryan, 2012). There are many reasons that students might be motivated to engage in a task, and that includes students being interested in the task or perceiving that the task having some sort of utility value, as well as students wanting to please their teachers/professors or wanting to show classmates how smart they are. These are all very different reasons for wanting to engage in a task. Does it matter whether participants' effort is self-initiated for intrinsic reasons (i.e., interest in the topic) versus for extrinsic reasons (i.e., to get a good grade on a test or because they want to prove to someone else that they can complete a task)? Would this lead to different perceptions of the relation between effort and ability? For example, if participants' effort is self-initiated because of intrinsic reasons, will there be a stronger positive relation between effort and ability than in participants' effort is self-initiated because of extrinsic reasons? Or is the important part that participants simply perceive that their effort is motivated by *themselves* (in whatever capacity) and their desire to go beyond the basic requirements of the task? Future research could examine this by trying to manipulate students' perceptions of self-initiated effort in more subtle and complex ways.

Researchers could extend this work by examining other motivation and achievement outcomes in addition to students' perceptions of their own abilities. Specifically, researchers could look at how perceived effort source in a particular class context influences behavioral outcomes such as actual persistence on an academic task, or students' grades in a class. Researchers could also investigate when it might be useful for students to perceive their own or others' effort as task-elicited, and when it might be useful to perceive effort as self-initiated. As discussed above, researchers need to more directly connect students' perceived effort source to motivationally beneficial outcomes in order to further explore the extent to which these perceptions are important. This type of work could be used to inform the creation or modification of actual interventions for students aimed to help increase their motivation in school.

Researchers could also explore individual differences in students' tendencies to perceive effort and task-elicited or self-initiated. Perhaps some students are more likely to assume their own and others' effort is task-elicited, whereas other students are more likely to assume that their own and others' effort is self-initiated even within the same context. Individual differences in perceived effort source could be related to students' theories of intelligence (Dweck, 1999), with entity theorists being more likely to perceive effort as task-elicited and incremental theorists being more likely to perceive effort as self-initiated. Researchers could test this hypothesis. Additionally, this work could extend to include cultural differences, such as the extent to which Asian students may perceive effort differently than White students (e.g., Hsin & Xie, 2014).

Researchers could also extend this work to younger students in order to explore the developmental progression of students' perceptions of effort source in school contexts. Perhaps it is not until children are able to perceive an inverse relation between effort and ability that their perceptions of effort source influence their motivation. Or, perhaps even students who are able to perceive an inverse relation between effort and ability are still not able to pick up on the nuances of task-elicited and self-initiated effort until they are older. There is also the question of whether younger students spontaneously form these perceptions on their own in school contexts, or whether they would only be sensitive to effort source information if researchers explicitly gave them effort source information. This work could ultimately help inform interventions intended to target younger students.

Researchers could also conduct longitudinal studies in order to examine: 1) whether students' perceptions of effort source influence longer-term outcomes such as grades or standardized test scores; and 2) the extent to which students' perceptions of effort source change over time and in different situations. These studies could help researchers understand whether students' effort source perceptions in particular contexts are more strongly influenced by the situation one is in, or more stable individual differences. Or, perhaps in some contexts the situation and individual are equally important. It could also answer developmental questions about how these perceptions change over time. Additionally, if researchers found that these perceptions influenced longer-term outcomes than just students' self-evaluations of ability, this would provide a strong rationale for researchers to try to intervene in how students think about the source of their own or others' effort.

With respect to the social comparison component of the study, in the future researchers could investigate how students make evaluations of themselves as compared to "generalized others" (i.e., "Everyone in the class is finishing this with less effort than I because they *all* find the task to be easy") as opposed to a single individual. Perhaps the relation between perceived effort source and students' self-evaluations of ability would be stronger in cases where students compare themselves to a group of peers versus a single peer; this is an important extension of the current studies.

Researchers could include “effort distance” as a variable in future studies instead of just controlling for it. It might be interesting to see how the difference between how much effort students perceive they exerted themselves versus how much effort students perceive that others exerted might influence students’ reasoning about effort and ability and their ability evaluations of others compared to themselves. For example, perhaps the larger the distance between my effort and someone else’s effort, the more strongly task-elicited perceptions are going to affect how I evaluate my ability compared to someone else. Future work could test whether effort distance might moderate the relation between perceived effort source and perceived relation between effort and ability. Furthermore, in studies where participants complete a task, researchers could actually measure students’ effort in a more objective way (such as time spent on task) in addition to having them rate their effort on a 1-10 point scale; it might be interesting to examine whether the findings are replicated using different conceptualizations of “effort”.

Finally, related to this point, there is a broader issue of how researchers define and measure effort. One critical question for future researchers to explore in more depth is: What *is* effort, and what does it look like in school (e.g., time on task, concentration, help seeking)? Do researchers, school administrators, teachers, students, and parents have similar beliefs about what effort is and why it is important, or do these beliefs and assumptions differ? Many researchers who study effort or include effort as a variable in their studies often fail to define it, either because they assume that the definition is self-explanatory, or because there is no strong theoretical basis for a definition of effort. The present studies provide some evidence that effort can be conceptualized in different ways and that there are different aspects of effort (i.e., level and source) that are critical; however, there is a lot of work to be done on deeply understanding what effort is and how different people define it.

Conclusion

In the present set of studies I investigated whether perceived effort source influenced students' self-evaluations of ability as compared to others when responding to hypothetical vignettes (Study 1) and when completing an actual academic task (Study 2). Results from Study 1 supported my hypotheses and prior research, whereas results from Study 2 did not. There are several possible explanations for these inconsistent findings. There are also many important theoretical and some practical implications of the results. Future work should address some of the limitations of the present studies and build on this work in order to increase our understanding of how perceived effort source influences students' motivation.

Appendix A: Vignettes and Demographic Questions for Study 1

__NOTE__: Will create a "male" version and a "female" version of these vignettes and participants will ONLY view the vignettes that correspond to their gender. (Males will be comparing themselves to other males; females will be comparing themselves to other females). Also will include two vignettes per condition to increase reliability—a "Calculus class" version and "Statistics class" version, but will randomize them so that there are two Blocks to minimize the chances that participants get two vignettes of the same condition in a row.

There will be a break after the first four vignettes that participants view. The break will be two minutes long and participants will be asked to name as many U.S. state capitals as they can in two minutes by typing them into a text box on the screen. After the break, they will be able to continue with the vignettes.

Instructions: Welcome!

Before we begin, please answer the following question.

How would you evaluate your own mathematics ability? (Slider scale from 1-100; anchors are "very low" and "very high")

Please read the following hypothetical scenarios.

Although the scenarios will seem similar to one another, there are some key differences, so it is important that you read each one carefully.

In each scenario, you will be asked to imagine that you are in a college level class next to another student. You will be given some information and then asked to evaluate your own ability as compared to the other student. You will then be given additional information and asked to evaluate your own ability as compared to the other student again. You will make a total of three evaluations per scenario. Please make your evaluations based on what you think is **most likely** given the information.

Finally, at the end of the study, you will be asked to indicate your agreement or disagreement with a few additional statements about yourself.

There are no right or wrong answers; we are interested in your opinions.

__**Task-elicited condition**__

Vignette 1a: High effort, low score [Jennifer/John]

Imagine that you were sitting in a college-level Calculus class next to another student, Jennifer. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took the full 15 minutes and worked hard on the problems, whereas Jennifer only took 5 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you felt that they were very difficult, whereas Jennifer did not work hard on the problems because she felt that they were very easy.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Jennifer received a 90%.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 1b: High effort, low score [Sarah/Matt]

Imagine that you were sitting in a college-level Statistics class next to another student, Sarah. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took the full 20 minutes and worked hard on the problems, whereas Sarah only took 7 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you felt that they were very difficult, whereas Sarah did not work hard on the problems because she felt that they were very easy.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Sarah received a 90%.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 2a: High effort, high score [Rebecca/Ben]

Imagine that you were sitting in a college-level Calculus class next to another student, Rebecca. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took the full 15 minutes and worked hard on the problems, whereas Rebecca only took 5 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you felt that they were very difficult, whereas Rebecca did not work hard on the problems because she felt that they were very easy.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Rebecca received a 70%.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 2b: High effort, high score [Emily/Samuel]

Imagine that you were sitting in a college-level Statistics class next to another student, Emily. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took the full 20 minutes and worked hard on the problems, whereas Emily only took 7 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you felt that they were very difficult, whereas Emily did not work hard on the problems because she felt that they were very easy.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Emily received a 70%.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 3a: Low effort, low score [Hannah/Joe]

Imagine that you were sitting in a college-level Calculus class next to another student, Hannah. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took only 5 minutes and did not work very hard on the problems, whereas Hannah took the full 15 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you felt that they were very easy, whereas Hannah worked hard on the problems because she felt that they were very difficult.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Hannah received a 90%.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 3b: Low effort, low score [Stephanie/Adam]

Imagine that you were sitting in a college-level Statistics class next to another student, Stephanie. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took only 7 minutes and did not work very hard on the problems, whereas Stephanie took the full 20 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Stephanie's?
(1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you felt that they were very easy, whereas Stephanie worked hard on the problems because she felt that they were very difficult.

Based on this information, how would you evaluate your math ability compared to Stephanie's?
(1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Stephanie received a 90%.

Based on this information, how would you evaluate your math ability compared to Stephanie's?
(1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much

higher)

Vignette 4a: Low effort, high score [Christina/Jeff]

Imagine that you were sitting in a college-level Calculus class next to another student, Christina. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took only 5 minutes and did not work very hard on the problems, whereas Christina took the full 15 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Christina's?
(1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you felt that they were very easy, whereas Christina worked hard on the problems because she felt that they were very difficult.

Based on this information, how would you evaluate your math ability compared to Christina's?
(1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Christina received a 70%.

Based on this information, how would you evaluate your math ability compared to Christina's?
(1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 4b: Low effort, high score [Grace/Ryan]

Imagine that you were sitting in a college-level Statistics class next to another student, Grace. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took only 7 minutes and did not work very hard on the problems, whereas Grace took the full 20 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Grace's?
(1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you felt that they were very easy, whereas Grace worked hard on the problems because she felt that they were very difficult.

Based on this information, how would you evaluate your math ability compared to Grace's?
(1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Grace received a

70%.

Based on this information, how would you evaluate your math ability compared to Grace's?
(1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

<u>Self-initiated condition</u>

Vignette 1a: High effort, low score [Jennifer/John]

Imagine that you were sitting in a college-level Calculus class next to another student, Jennifer. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took the full 15 minutes and worked hard on the problems, whereas Jennifer only took 5 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you were motivated, whereas Jennifer did not work hard on the problems because she was not motivated.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Jennifer received a 90%.

Based on this information, how would you evaluate your math ability compared to Jennifer's?
(1 = Jennifer's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 1b: High effort, low score [Sarah/Matt]

Imagine that you were sitting in a college-level Statistics class next to another student, Sarah. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took the full 20 minutes and worked hard on the problems, whereas Sarah only took 7 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you were motivated, whereas Sarah did not work hard on the problems because she was not motivated.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Sarah received a 90%.

Based on this information, how would you evaluate your math ability compared to Sarah's?
(1 = Sarah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 2a: High effort, high score [Rebecca/Ben]

Imagine that were sitting in a college-level Calculus class next to another student, Rebecca. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took the full 15 minutes and worked hard on the problems, whereas Rebecca only took 5 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you were motivated, whereas Rebecca did not work hard on the problems because she was not motivated.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Rebecca received a 70%.

Based on this information, how would you evaluate your math ability compared to Rebecca's?
(1 = Rebecca's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 2b: High effort, high score [Emily/Samuel]

Imagine that were sitting in a college-level Statistics class next to another student, Emily. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took the full 20 minutes and worked hard on the problems, whereas Emily only took 7 minutes and did not work hard on the problems.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you worked hard on the problems because you were motivated, whereas Emily did not work hard on the problems because she was not motivated.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Emily received a 70%.

Based on this information, how would you evaluate your math ability compared to Emily's?
(1 = Emily's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 3a: Low effort, low score [Hannah/Joe]

Imagine that you were sitting in a college-level Calculus class next to another student, Hannah. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took only 5 minutes and did not work very hard on the problems, whereas Hannah took the full 15 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you were not motivated, whereas Hannah worked hard on the problems because she was motivated.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Hannah received a 90%.

Based on this information, how would you evaluate your math ability compared to Hannah's?
(1 = Hannah's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 3b: Low effort, low score [Stephanie/Adam]

Imagine that you were sitting in a college-level Statistics class next to another student, Stephanie. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took only 7 minutes and did not work very hard on the problems, whereas Stephanie took the full 20 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Stephanie's?
(1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much

higher)

Imagine that you did not work hard on the problems because you were not motivated, whereas Stephanie worked hard on the problems because she was motivated.

Based on this information, how would you evaluate your math ability compared to Stephanie's? (1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 70%, while Stephanie received a 90%.

Based on this information, how would you evaluate your math ability compared to Stephanie's? (1 = Stephanie's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 4a: Low effort, high score [Christina/Jeff]

Imagine that you were sitting in a college-level Calculus class next to another student, Christina. The professor gave everyone in the class a set of problems to work on individually for 15 minutes. You took only 5 minutes and did not work very hard on the problems, whereas Christina took the full 15 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Christina's? (1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you were not motivated, whereas Christina worked hard on the problems because she was motivated.

Based on this information, how would you evaluate your math ability compared to Christina's? (1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Christina received a 70%.

Based on this information, how would you evaluate your math ability compared to Christina's? (1 = Christina's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Vignette 4b: Low effort, high score [Grace/Ryan]

Imagine that you were sitting in a college-level Statistics class next to another student, Grace. The professor gave everyone in the class a set of problems to work on individually for 20 minutes. You took only 7 minutes and did not work very hard on the problems, whereas Grace took the full 20 minutes and worked hard on the problems.

Based on this information, how would you evaluate your math ability compared to Grace's? (1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Imagine that you did not work hard on the problems because you were not motivated, whereas Grace worked hard on the problems because she was motivated.

Based on this information, how would you evaluate your math ability compared to Grace's? (1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

After class, the professor graded the problems. You received a 90%, while Grace received a 70%.

Based on this information, how would you evaluate your math ability compared to Grace's? (1 = Grace's ability is much higher; 5 = We have the same ability; 9 = My ability is much higher)

Iowa-Netherlands Comparison Orientation Measure (Modified)

Most people compare themselves from time to time with others. For example, they may compare the way they feel, their opinions, their abilities, and/or their situation with those of other people. There is nothing particularly 'good' or 'bad' about this type of comparison, and some people do it more than others. We would like to find out how often you compare yourself with other people. To do that we would like to ask you to indicate how much you agree with each statement below, by using the following scale.

1. I always pay a lot of attention to how I do things compared with how others do things.
2. If I want to find out how well I have done something, I compare what I have done with how others have done.
3. I am not the type of person who compares myself often with others. (R)
4. I often compare myself with others with respect to what I have accomplished in life.
5. If I want to learn more about something, I try to find out what others think about it.
6. I *never* consider my situation in life in relative to that of other people. (R)

Scale: 1 = I disagree strongly, 5 = I agree strongly

Additional Social Comparison Items

1. I often compare myself to other students in my classes to determine how well I am doing academically. (1 = I disagree strongly, 5 = I agree strongly)
2. When I am uncertain of how well I am doing in a class, I try to figure out how well others are doing. (1 = I disagree strongly, 5 = I agree strongly)

3. I like to have information about how well other students are doing in my classes. (1 = I disagree strongly, 5 = I agree strongly)
4. I frequently use information about how well other students are doing in my classes to figure out how well I am doing. (1 = I disagree strongly, 5 = I agree strongly)
5. In general how much information is available to you about how others are doing in your college classes? (1 = Very little, 5 = A lot)

Theories of Intelligence Questionnaire

Next, we are interested in your general beliefs about intelligence. There are no right or wrong answers. We are interested in your opinions. Please read each item carefully and rate the extent to which you agree or disagree with the item using the scale that appears below it.

1. You have a certain amount of intelligence, and you really can't do much to change it.
2. Your intelligence is something about you that you can't change very much.
3. No matter who you are, you can significantly change your intelligence level.
4. To be honest, you can't really change how intelligent you are.
5. You can always substantially change how intelligent you are.
6. You can learn new things, but you can't really change your basic intelligence.
7. No matter how much intelligence you have, you can always change it quite a bit.
8. You can change even your basic intelligence level considerably.

Demographic questions

1. Please indicate your age:

2. Please indicate your sex:

3. Please indicate your ethnicity:

African-American, Black, African, Caribbean
Asian-American, Asian, Pacific Islander
European-American, Anglo, Caucasian
Hispanic-American, Latino/a, Chicano/a
Native American, American Indian
Bi-racial, Multi-racial

4. Which of these categories does your major best fit into? (Agriculture/Natural Resources; Architecture, Planning, and Preservation; Arts and Humanities; Behavioral and Social Sciences; Business; Computer, Mathematical, and Natural Sciences; Education; Engineering; Journalism; Information Studies; Public Health; Public Policy; Other)

Debriefing information

Thank you for your participation in this study!

The purpose of this study is to examine whether undergraduate students' thinking about their own effort (e.g., whether they believe it was driven by the task or initiated by their own motivation) influence how they evaluate their own academic ability in situations where they put forth high or low levels of effort. Participants were randomly assigned to one of two hypothetical vignette conditions. Half of the participants were told that high or low effort was caused by the subjective ease or difficulty of the task, whereas the other half of participants were told that high or low effort was caused by one's own motivation or lack of motivation. We are curious to see whether these different cues about effort *source* influence whether students think about effort *level* as positively or negatively related to their ability.

As part of this study, you completed a task in which you were asked to list US state capitals. This was simply a distractor task, and did not have anything to do with the main hypotheses of the study.

Results from these studies can help researchers and educators better understand what types of effort information students use when forming self-evaluations of ability, which are important to students' motivation and achievement in school.

It is very important that other participants in this study come in without knowing exactly what we are studying so that their responses are completely honest. For this reason, please do not talk about this study with any of your classmates or friends who may participate in this study. Prior expectations may influence the findings unintentionally and thus make our efforts (and yours) potentially less useful and informative.

If you have further questions, please direct your inquiries to Katherine Muenks (kmuenks@umd.edu). Thank you again for your participation!

Appendix B: Recipe Task, Manipulations, and Demographic Questions for Study 2

NOTE: Will have a male and female version of this study.

Instructions: Welcome!

Before we begin, please answer the following question.

How would you evaluate your own mathematics ability? (Slider scale from 1-100; anchors are "very low" and "very high")

You will now be asked to complete a math task having to do with modifying recipes. This is the same task that another [female/male] undergraduate participant completed a few days ago.

For this task, you will be provided with four different recipes. Each recipe will include a list of ingredients with specific quantities. You will then be asked to change those quantities, for example by **doubling** or **halving** the recipes, without using a calculator. Please reduce the fraction to its simplest form. For all fractions greater than 1, you will need to provide your answers as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25).

Priming

Task-elicited condition: A lot of people work hard on this task because it is difficult.
Self-initiated condition: A lot of people work hard on this task because they feel motivated to complete it.
Control condition: A lot of people work hard on this task.

Please complete this task in one sitting, without stopping. You may use a pen and paper, but please do NOT use a calculator.

Click "Continue" to begin.

Recipe #1: Chocolate chip cookies [ADD PHOTO]

This recipe calls for 12 servings, and you would like to make 4 servings. Please calculate new quantities for all of the ingredients given this change. It is very important that all of the ingredients are calculated correctly. Please note that some fractions may be unusual.

Please reduce the fraction to its simplest form. For any fractions greater than 1, provide the new quantities for the ingredients as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25). Provide answers in the same ingredient units (e.g., cups, tablespoons, etc.) as the original recipe calls for. In your answer, write both the fraction and ingredient unit.

Please write the new quantities in the spaces below the original quantities. When you are done, click "Continue." Once you click "Continue", you will not be able to go back.

2 ¼ cups all-purpose flour
1 ¼ teaspoon baking soda
1 teaspoon salt
¾ teaspoon vanilla extract
2 1/3 cups butter
2/3 cup granulated sugar
3/5 cup packed brown sugar
3 large eggs
2 ½ cups semi-sweet chocolate chip morsels
1 cup chopped nuts

Recipe #2: Chicken meatballs [ADD PHOTO]

This recipe calls for 12 servings, and you would like to make 3 servings. Please calculate new quantities for all of the ingredients given this change. It is very important that all of the ingredients are calculated correctly. Please note that some fractions may be unusual.

Please reduce the fraction to its simplest form. For any fractions greater than 1, provide the new quantities for the ingredients as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25). Provide answers in the same ingredient units (e.g., cups, tablespoons, etc.) as the original recipe calls for. In your answer, write both the fraction and ingredient unit.

Please write the new quantities in the spaces below the original quantities. When you are done, click "Continue." Once you click "Continue", you will not be able to go back.

¾ pound boneless, skinless chicken breasts
2 bacon strips
3 ½ slices sandwich bread
2 3/4 teaspoons chili powder
½ teaspoon cayenne pepper
2/3 teaspoon kosher salt
¼ cup whole milk
1 large egg, lightly beaten
5/6 small onion, finely chopped
2 4/7 garlic cloves
1/3 cup grated Parmesan cheese
3/5 cup vegetable oil
3 oz fresh flat-leaf parsley

Recipe #3: Three-bean chili [ADD PHOTO]

This recipe calls for 24 servings, and you would like to make 4 servings. Please calculate new quantities for all of the ingredients given this change. It is very important that all of the ingredients are calculated correctly. Please note that some fractions may be unusual.

Please reduce the fraction to its simplest form. For any fractions greater than 1, provide the new quantities for the ingredients as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25). Provide answers in the same ingredient units (e.g., cups, tablespoons, etc.) as the original recipe calls for. In your answer, write both the fraction and ingredient unit.

Please write the new quantities in the spaces below the original quantities. When you are done, click "Continue." Once you click "Continue", you will not be able to go back.

1 3/4 tablespoon olive oil
1 2/3 medium onion, chopped
2 peppers, finely chopped
3 3/4 cloves garlic, minced
1 7/8 tablespoons chili powder
2 1/5 teaspoons ground cumin
1 teaspoon dried oregano
4 ½ teaspoons kosher salt
14 oz. beer
28 oz. crushed tomatoes
1 ½ cups mixed dried beans
3 1/4 cups water

Recipe #4: Onion rolls [ADD PHOTO]

This recipe calls for 12 servings, and you would like to make 24 servings. Please calculate new quantities for all of the ingredients given this change. It is very important that all of the ingredients are calculated correctly. Please note that some fractions may be unusual.

Please reduce the fraction to its simplest form. For any fractions greater than 1, provide the new quantities for the ingredients as mixed numbers (e.g., 1 ¼), rather than improper fractions (e.g., 5/4) or decimals (e.g., 1.25). Provide answers in the same ingredient units (e.g., cups, tablespoons, etc.) as the original recipe calls for. In your answer, write both the fraction and ingredient unit.

Please write the new quantities in the spaces below the original quantities. When you are done, click “Continue.” Once you click “Continue”, you will not be able to go back.

3/5 cup milk
5 2/3 tablespoons water
3 1/3 tablespoons butter, softened
1 ½ teaspoons salt
3 tablespoons white sugar
1 1/8 teaspoon onion powder
3 3/4 tablespoons dried minced onion
¼ cup instant potato flakes
2 2/7 cups all-purpose flour
¼ oz. yeast
1 egg white
4/5 tablespoon water
6/7 cup dried minced onion

On a scale from 1 to 10, how much effort did you feel that you exerted on this task? (1 = very little effort at all, 10 = a great deal of effort)

Effort Source Manipulation

Task-elicited condition:

Now, please reflect on the recipe task that you just completed by responding to some open-ended questions about the task. Please respond to each question using at least **two** sentences. There are no right or wrong answers; we are interested in your opinions.

1. In general, why was this task difficult OR easy?
2. What specific aspects of the task were most difficult?
3. What specific aspects of the task were easiest?
4. What would have made this task easier?
5. What would have made this task more difficult?

Self-initiated condition:

Now, please reflect on the recipe task that you just completed by responding to some open-ended questions about the task. Please respond to each question using at least **two** sentences. There are no right or wrong answers; we are interested in your opinions.

1. In general, why were you motivated OR not motivated to complete this task?
2. What, specifically, increased your motivation during the task?
3. What, specifically, decreased your motivation during the task?
1. What would have made you less motivated during the task?
2. What would have made you more motivated during the task?

Control condition:

[Nothing]

Level of Effort Manipulation

Now, I want you to compare your ability to the other [female/male] undergraduate participant who completed the task a few days ago. But first, I want to give you some information about that participant's effort.

The other participant finished the task approximately 5 minutes [slower/faster] than you.

You indicated the level of your effort as a ___, and the other participant indicated [his/her] level of effort as a ___. [3 points higher/lower]

More effort condition:
If they said 1, the other person said 1 (Distance = 0)

If they said 2, the other person said 1 (Distance = 1)
If they said 3, the other person said 1 (Distance = 2)
If they said 4, the other person said 1 (Distance = 3)
If they said 5, the other person said 2 (Distance = 3)
If they said 6, the other person said 3 (Distance = 3)
If they said 7, the other person said 4 (Distance = 3)
If they said 8, the other person said 5 (Distance = 3)
If they said 9, the other person said 6 (Distance = 3)
If they said 10, the other person said 7 (Distance = 3)

Less effort condition:
If they said 1, the other person said 4 (Distance = 3)
If they said 2, the other person said 5 (Distance = 3)
If they said 3, the other person said 6 (Distance = 3)
If they said 4, the other person said 7 (Distance = 3)
If they said 5, the other person said 8 (Distance = 3)
If they said 6, the other person said 9 (Distance = 3)
If they said 7, the other person said 10 (Distance = 3)
If they said 8, the other person said 10 (Distance = 2)
If they said 9, the other person said 10 (Distance = 1)
If they said 10, the other person said 10 (Distance = 0)

NOTE: Will try to equalize effort distance so that it is always 3. However, if some participants respond on the extremes of the scale (and thus the distance will need to be less than 3), I will create an "Effort Distance" variable and control for it by using it as a covariate.

Ratings of ability

- Please evaluate your own ability on this specific fraction task compared to the other participant's. (1 = [His/her] ability is much higher; 5 = Our abilities are the same; 9 = My ability is much higher)
- Please evaluate your own general fraction ability compared to the other participant's. (1 = [His/her] ability is much higher; 5 = Our abilities are the same; 9 = My ability is much higher)
- Please evaluate your own general math ability compared to the other participant's. (1 = [His/her] ability is much higher; 5 = Our abilities are the same; 9 = My ability is much higher)

Iowa-Netherlands Comparison Orientation Measure (Modified)

Most people compare themselves from time to time with others. For example, they may compare the way they feel, their opinions, their abilities, and/or their situation with those of other people. There is nothing particularly 'good' or 'bad' about this type of comparison, and some people do it more than others. We would like to find out how often you compare yourself with other people. To do that we would like to ask you to indicate how much you agree with each statement below, by using the following scale.

1. I always pay a lot of attention to how I do things compared with how others do things.
2. If I want to find out how well I have done something, I compare what I have done with how others have done.
3. I am not the type of person who compares often with others. (R)
4. I often compare myself with others with respect to what I have accomplished in life.
5. If I want to learn more about something, I try to find out what others think about it.
6. I *never* consider my situation in life in relative to that of other people. (R)

Scale: 1 = I disagree strongly, 5 = I agree strongly

Additional Social Comparison Items

1. I often compare myself to other students in my classes to determine how well I am doing academically. (1 = I disagree strongly, 5 = I agree strongly)
2. When I am uncertain of how well I am doing in a class, I try to figure out how well others are doing. (1 = I disagree strongly, 5 = I agree strongly)
3. I like to have information about how well other students are doing in my classes. (1 = I disagree strongly, 5 = I agree strongly)
4. I frequently use information about how well other students are doing in my classes to figure out how well I am doing. (1 = I disagree strongly, 5 = I agree strongly)
5. In general how much information is available to you about how others are doing in your college classes? (1 = Very little, 5 = A lot)

Theories of Intelligence Questionnaire

Next, we are interested in your general beliefs about intelligence. There are no right or wrong answers. We are interested in your opinions. Please read each item carefully and rate the extent to which you agree or disagree with the item using the scale that appears below it.

1. You have a certain amount of intelligence, and you really can’t do much to change it.
2. Your intelligence is something about you that you can’t change very much.
3. No matter who you are, you can significantly change your intelligence level.
4. To be honest, you can’t really change how intelligent you are.
5. You can always substantially change how intelligent you are.
6. You can learn new things, but you can’t really change your basic intelligence.
7. No matter how much intelligence you have, you can always change it quite a bit.
8. You can change even your basic intelligence level considerably.

Demographic questions

1. Please indicate your age:

2. Please indicate your sex:

3. Please indicate your ethnicity:

African-American, Black, African, Caribbean
Asian-American, Asian, Pacific Islander
European-American, Anglo, Caucasian
Hispanic-American, Latino/a, Chicano/a
Native American, American Indian
Bi-racial, Multi-racial

4. Which of these categories does your major best fit into? (Agriculture/Natural Resources; Architecture, Planning, and Preservation; Arts and Humanities; Behavioral and Social Sciences; Business; Computer, Mathematical, and Natural Sciences; Education; Engineering; Journalism; Information Studies; Public Health; Public Policy; Other)

Debriefing information

Thank you for your participation in this study!

The purpose of this study is to examine whether undergraduate students' thinking about their own effort influence how they evaluate their academic ability in situations where they put forth high or low levels of effort. Participants were randomly assigned to one of three "effort source" conditions: The "task-elicited" condition (where they were led to believe their effort on the task was driven by the demands of the task), the "self-initiated" condition (where they were led to believe their effort was driven by their own motivation), or the "control" condition (where they were not given any information about the source of their effort). Participants were also assigned to one of two "effort level" conditions: The "high effort" condition (where they were told they exerted more effort than another participant) or the "low effort" condition (where they were told they exerted less effort than another participant).

As part of this study, we told you that another participant had previously completed the task and that he or she had exerted either more or less effort than you did on the task. There was really no "other" participant. This was part of the manipulation. We apologize for the deception. However, we felt that this was the best way to examine how your ability evaluations changed based on information you received about the level of your effort on the task as compared to another student.

We are interested in examining whether participants' perceptions of the source of their own effort influenced whether they conceived of a positive or an inverse relation between levels of their effort and ability. Results from these studies can help researchers and educators better understand what types of effort information students use when forming self-evaluations of ability, which are important to students' motivation and achievement.

So, that's a basic description of what the study is about. It is very important that other participants in this study come in without knowing exactly what we are studying so that their responses are completely honest. For this reason, please do not talk about this study with any of your classmates or friends who may participate in this study. Prior expectations may influence the findings unintentionally and thus make our efforts (and yours) potentially less useful and informative.

If you have further questions, please direct your inquiries to Katherine Muenks (kmuenks@umd.edu). Thank you again for your participation!

Appendix C: Additional tables

Table 2

Means and standard errors for effort source x effort level x ability evaluation order three-way interaction in Study 1

		Task-elicited		Self-initiated	
		M	SE	M	SE
Low effort	Evaluation 1	6.30	0.13	5.64	0.13
	Evaluation 2	7.04	0.12	4.61	0.12
	Evaluation 3	5.77	0.08	5.58	0.08
High effort	Evaluation 1	4.06	0.14	4.64	0.14
	Evaluation 2	3.29	0.13	5.74	0.13
	Evaluation 3	4.62	0.08	4.81	0.08

Note. SE = standard error. There were four covariates included: students' initial beliefs about their mathematics ability, social comparison orientation, amount of social comparison information available to them in general, and theories of intelligence.

Table 3

Means and standard errors for effort source x effort level interaction for specific fraction task ability in Study 2

	Task-elicited		Control		Self-initiated	
	M	SE	M	SE	M	SE
Low effort	5.42	0.38	6.05	0.33	6.31	0.34
High effort	5.12	0.34	3.66	0.32	4.14	0.34

Note. SE = standard error. There were five covariates included: effort distance, students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence.

Table 4

Means and standard errors for effort source x effort level interaction for fraction ability in Study 2

	Task-elicited		Control		Self-initiated	
	M	SE	M	SE	M	SE
Low effort	5.46	0.32	5.84	0.28	6.22	0.29
High effort	4.93	0.28	4.37	0.27	4.64	0.28

Note. SE = standard error. There were five covariates included: effort distance, students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence.

Table 5

Means and standard errors for effort source x effort level interaction for math ability in Study 2

	Task-elicited		Control		Self-initiated	
	M	SE	M	SE	M	SE
Low effort	5.64	0.37	5.95	0.32	6.23	0.33
High effort	5.30	0.33	4.09	0.32	4.30	0.33

Note. SE = standard error. There were five covariates included: effort distance, students' initial beliefs about math ability, students' social comparison orientation, social comparison information available, and theories of intelligence.

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